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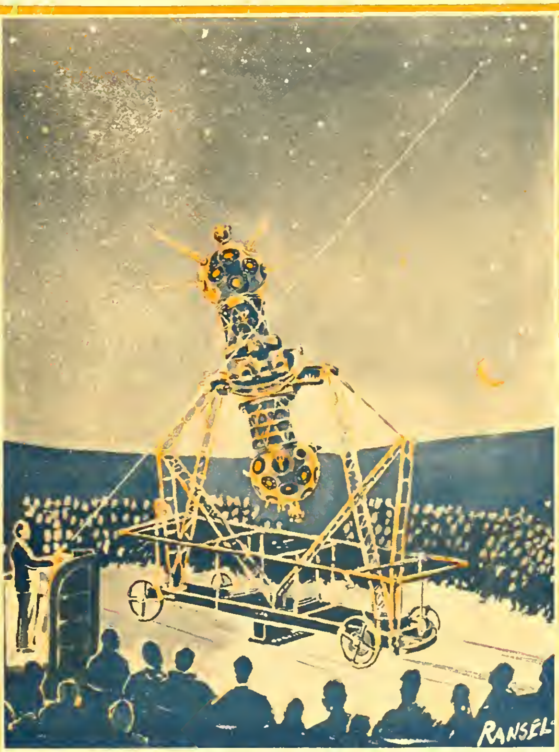

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VOL. XXI. NOVEMBER, 1929 NO. 1

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A NEW DESIGN

BOX-HEADER BOILER

The new C-E Single-Seam Box-Header Boiler is a distinct advance in construction and design over ordinary box header practice.

In the new design —

The wrapper or butt strap joining the tube and hand hole sheets is —ELIMINATED.

ONE ROW OF RIVETS JOINS THE TUBE SHEET DIRECTLY TO THE HAND HOLE SHEET.

The row of rivets on the tube side of the wrapper strap is —ELIMINATED.

THERE IS ONLY ONE CAULKING EDGE and this faces the outside — making inspection easy and removing all rivets out of the hot gas and fire zones.

Three thicknesses of metal at the caulking joint at the ears are — REDUCED TO TWO THICKNESSES.

This new design provides an unusual factor of safety. For instance, in the standard unit sold for 160 lb. to 250 lb. working pressure, the header joint is adequate for a working pressure of 450 lb.

A careful inspection of this new boiler will convince you that the C-E Box-Header Boiler is a better Box-Header Boiler.

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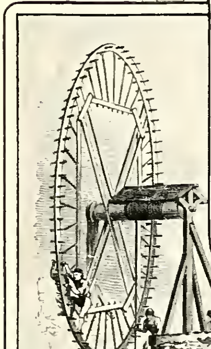

Reproduction of an old wood-cut showing one of the early phases of Vertical Transportation

THE ROYAL YORK HOTEL, TORONTO, CANADA
Ross & MacDonald, Architects *Sproat & Rolph, Associate Architects*

The Tallest Building in the British Empire

THE new Royal York Hotel, Toronto, Canada, is the British Empire's tallest building and its largest hotel. This immense structure embodies modern improvements throughout and particularly in regard to Vertical Transportation, which is provided by seventeen elevators of Otis-Fensom manufacture. Ten of these are Otis Signal Control elevators, and the remainder are equipped with Otis "Flying Stop" control.

Here again is found proof of the saying that "most of the world's famous buildings are Otis-equipped."

OTIS ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

37412

WHAT YOUNGER COLLEGE MEN
ARE DOING WITH WESTINGHOUSE

This 5000 h.p. motor in the Columbia Steel Company's Plant, with its frame of arc-welded steel, is physically the largest synchronous motor ever built.

Ninety days to go—
teamwork wins

While you Seniors were shuffling worries about machine stresses and saturation curves with those of football last fall, a group of your predecessors, not so many years ahead of you, were playing the game with grim realities.

The Columbia Steel Company of Pittsburg, California, completed plans on September 12th to build a new tinplate plant. On the 13th they gave an order to Westinghouse for two 5,000 horsepower synchronous motors to drive the rolls, to be physically the largest synchronous motors ever built. Delivery of the first was wanted in ninety days.

Ninety days in which to design, manufacture, assemble, test and ship any large unit, let alone a new achievement in size and type of construction, affords no time for idle speculation. Westinghouse men went at the job as only an experienced and thoroughly equipped organization could do. And on the scheduled date, four flat cars and a box car rolled out of the Westinghouse plant, carrying the completed and tested motor.

It was an industrial victory, as satisfying as any athletic gain. Teamwork and individual skill had won. Westinghouse had once more made good and upheld the reputation that earns the big electrical jobs for Westinghouse men.

Westinghouse

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Oklahoma A & M College, '23

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VOLUME XXI NOVEMBER, 1929 NUMBER 1

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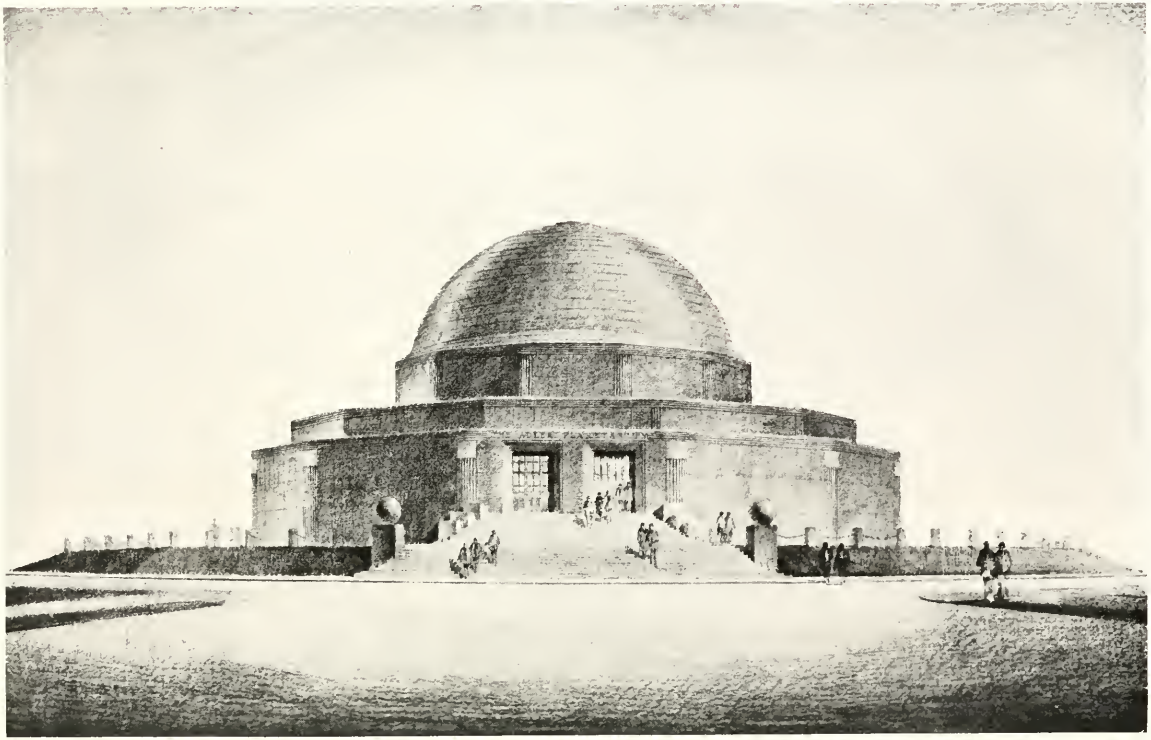


New Planetarium — Grant Park

The
ARMOUR ENGINEER

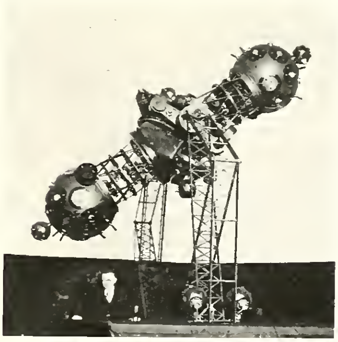
VOLUME XXI NOVEMBER, 1929 NUMBER 1

CHICAGO BUILDS THE FIRST PLANETARIUM IN THE UNITED STATES

By John A. Maloney

OUT on an island in Lake Michigan, just east of the Field Museum and the new Shedd Aquarium, speeding motorists along the outer drive have watched a new type of building being erected. A huge sign announces the fact that a Planetarium, a gift of Mr. Max Adler to the people of the city of Chicago, is to be housed in that building. It is small wonder if they do not give the matter much thought but speed on to Michigan Avenue saying to themselves, "A Planetarium. . . . I wonder what that is?" For this building is to house a pioneer in this country—the first planetarium in the United States.

A planetarium is, in a few words, a theatre in which a vaulted dome becomes a heavenly stage and the actors are the stars and planets. It is the product of Dr. Baursfeld, an engineer of the great Zeiss Optical Works at Jena, and his associates, who worked out a happy inspiration that occurred to the greatest showman since P. T. Barnum, Dr. Oskar von Miller, the Director of the Deutsches Museum of Munich. In 1903, von Miller conceived the idea of a great technical museum, and, calling together the heads of the great industries of Europe, he soon made his dream a reality. Machines moved and explained themselves to a million visitors a year in Munich. But though he had succeeded in organizing the greatest innovation in visual education that the world had ever seen, he wished to go further. He went to Dr. Baursfeld and said, in effect, "I have placed the intricacies of science, industry and engineering at the disposal of the people but there is one science which we cannot elucidate for them without special apparatus. Build me a theatre," he said, "in which the mysteries of astronomy will be so simplified that even a child can grasp them in a short time and yet let the spectacle be so realistic that the splendor of the evening sky will appear without the slightest tinge of artificiality." No small commission, this. And yet Baursfeld set to work at his task with typical German tenacity and thoroughness. Several times he thought he had the answer but the results did not satisfy him. It was 20 years before his task was completed and the first planetarium was shipped to Munich and installed in the Museum building.



Zeiss Planetarium. View of the projector.

We want to know, of course, what the origin and the history of the planetarium was, but we are more interested to know how it works and what we may expect to see when the Chicago edifice opens its doors to the public in 1930. Let us take an imaginary trip to this unique building on the lake shore about a year from now. A graceful, architecturally pleasing building, with a domed roof that resembles the housing of a telescope meets the eye. You enter and in what looks like an auditorium and you take your seat. Above you the vaulted dome stares down in monotonous whiteness. A great machine, mounted on wheels, occupies a prominent place on the floor. It attracts your attention because it is a monster and more grotesque than anything you have ever seen before. To be sure it looks like something that might have hopped out of Jules Verne's imagination and had come to rest on the shores of the Queen of the Lake. Structural steel girders support a cylindrical seesaw with a round head at each end. Glassy eyes stare out of the heads and the machine moves to and fro as an attendant tests it to make sure that all is in readiness. Off on the side the lecturer stands, behind a desk that contains as many buttons and signal lights as the keyboard of a great organ that you have seen arise from the basement of a motion picture palace. But you have no further opportunity for discovery or investigation.

The lights are extinguished and the hall is pitched into Stygian blackness for a few seconds. A whirr, and the motors start and the dome above you lights up with all the brilliance of a starlit night. A hush has fallen over the audience and it is several seconds before they realize just what has happened. A long drawn "a-a-ah" escapes involuntarily from the multitude, and even astronomers who have spent their lives in gazing on the beauties of the real firmament cannot refrain from voicing their admiration when this man-made spectacle greets them in the planetarium.

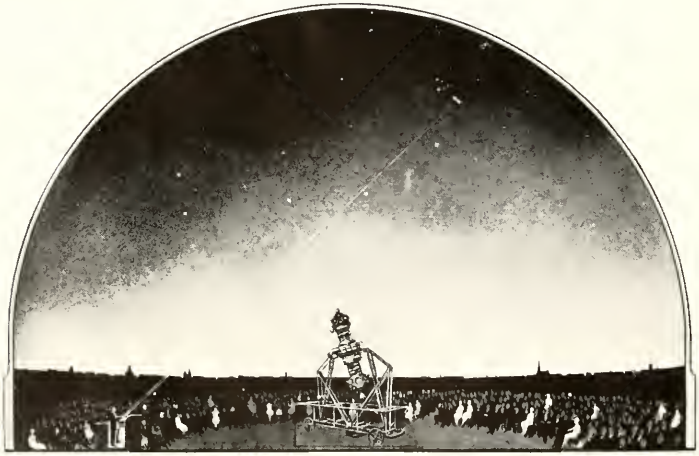
As the stars continue to gleam and twinkle the lecturer, armed with a pointer of light proceeds to familiarize the audience with the better known planets and to explain their movements. No drama of Shakespeare and none of the exploits of the insidious Doctor Fu Manchu were ever followed more intensely than is this new drama in which constellations, the planets and the stars take their cue from the awkward-looking "deus ex machina" that is the heart and soul and brains of the planetarium.

The wonders of the planetarium are not confined to pleasing the eye. Its aims are primarily educational and the amusement and pleasure that it affords are but secondary. There is no exaggeration in the statement that a person can learn more astronomy beneath its beautiful, artificial sky in a few hours than he could from years of studying text books or even by actual contemplation of the heavens. There are movements of the heavenly bodies that occupy thousands of years before they are complete and for that reason no man could ever witness the actual procedure in nature. Yet, in the planetarium he can see such a circuit in minutes and seconds.

Suppose we wish to know how the Antarctic sky appears to the members of the Byrd Expedition in Little America. At the touch of a button the firmament is whirled around and we are transported to the South Pole, there to view the sight that greets the intrepid explorers. We see how the stars travel over their appointed course, and how, in the course of 26,000 years the earth's axis performs a tumbling motion like a top that is "dying down." How did the sky appear to the Egyptians as they reared the great pyramids on the hot sands thousands of years ago? Saturn takes nearly thirty years to complete its trip around the sun and Neptune needs 166 years for the trip. What do they look like as they make their appointed rounds? Why do they not collide? All these questions which perplexed primitive man as he began to realize that the sun was not a fiery chariot driven across the sky each day, and which today still perplex the average man can be readily answered and impressed on the memory with the aid of this remarkable device.

The planetarium takes the slow motion pictures with which we are all familiar and reverses the process. On the star lit vault time overtakes itself and the instrument becomes a time compressor. It gives us the option of reducing a day to the space of one to four minutes and reproduces natural movements 1,140 times faster than they actually occur. The astronomical happenings of a year can be compressed into the space of seven seconds and thus the year is speeded up as much as four million times. Because of its brightness, the sun renders it quite difficult to observe celestial movements while it shines on our part of the earth but in the planetarium we simply turn out the light of the sun and proceed with our research.

Lecturer in the planetarium behind the switch board handling the luminous pointer.



Planetarium. Sectional view. The constellation is shown projected on the dome-like ceiling.

The programme which is offered by European planetaria is quite varied. Visitors do not wish to see the same thing always, no matter how arrestingly it may be presented. And so the directors are kept busy devising new effects. Views of the sky as it appears in the latitude in which the planetarium is located are followed by the explanation of the change of seasons. Here we learn what astronomers mean when they speak of the "precession of the equinoxes" and we also see that the change of seasons has a definite cause and is not the result of vagaries of the weather. We can take a trip to the land of the midnight sun or we may play with the heavens by stopping the sun or moon in their courses or by manipulating the firmament so that we have the phenomenon of eternal summer or everlasting winter. Merrily we trip around the world and view heavenly bodies that we would otherwise never see.

All of this is interesting to the engineer; but the main thing he wants to know is how does the thing work—what makes the "wheels go round?" The answer is contained in the grotesque machine that attracted our attention when we first entered the building. Its great, staring glass eyes are lenses and behind each lens is a projector—a stereoptican or lantern slide machine—no different in principle than its crude predecessor, "the magic lantern" that delighted our grandfathers. Motors swing the great cylinder to and fro at the touch of a button by the lecturer. One hundred and nineteen

(*Continued on page 26*)

TELEPHOTOGRAPHY

By Norman D. Buehling, '30

Student in the Department of Electrical Engineering

THE rapid advance of scientific knowledge has brought so many wonders within our grasp, that there is a tendency to take many of our present day developments for granted. For every new discovery that is made today, there will be many applications tomorrow. Emission of electrons, caused by a ray of light on an active metal, a scientific novelty of yesterday, today finds endless uses. Without the photo-electric cell, who could dream of television or of the telephotograph system? Every day photographs are sent from coast to coast; the process is taken as a matter of course, but few know the methods employed in accomplishing this feat.

The system of transmitting pictures electrically over great distances has been a reliable, commercial, accomplishment for a number of years. The American Telephone and Telegraph Company has developed the system and made it commercially possible. There are now stations in eight of our most important cities scattered over the country, and photographs can be sent almost anywhere in a very short time. The quality of the transmitted pictures are such that it is difficult to distinguish the telephoto, as it is called, from the original.

Photographing the picture, diagram or drawing, is the first step, and gives a negative plate. To obtain a positive film, the negative is rephotographed, and the positive film, 5x7 inches, is used in the actual transmitting. Usually a photographic reversal takes place, that is, when a positive is sent a negative is received and vice versa. However, this is not necessarily so, for by reversing the photo-electric cell connections, a positive can be made to produce a positive, and a negative to produce a negative. It is a general rule to send a positive and receive a negative. The actual time required to send a picture is seven minutes, but the associated photographic processes take from one-half to three-quarters of an hour.

The transparent positive is fastened on a cylindrical form. Focused on the film, and shining through it, on to a photo-electric cell, is a small rectangular beam of light. The film is rotated and caused to advance slowly, parallel to its axis, so that the light beam traverses the entire picture in a series of adjacent lines. As the film rotates the intensity of the light on the cell varies with the shade of the film at the point where the beam is focused. Variation of the light on the cell causes a variation of the current through it, and this current is amplified and used to modulate a 1,300 cycle carrier wave, which is sent over the telephone lines.

At the receiving end an unexposed firm is rotated on a form, in synchronism with the original picture. A light valve allows light to fall on the film, but with an intensity that varies with the strength of the current received from the telephone lines. The film can then be developed and the transmission is complete.

The telephotograph system can be divided into two separate and distinct parts; the picture system, and the control system. The picture system has to do with the transforming of light energy into electrical energy, its transmission over the lines, and the change back from electrical energy to light energy. The control system provides the means for starting both machines at the same time and maintaining synchronous speed. The operation of the picture system shall be treated first.

The 5x7-inch positive film is placed over a cylindrical form which mounts on a rotating shaft. A motor drives the shaft at 90 r. p. m. and as it revolves, the film advances along a lead screw one-hundredth of an inch per revolution. Light, from a stationary source, is focused on the film, and covers it in a series of adjacent lines. A small lamp of constant intensity throws a beam of light through a small aperture and it is focused, by means of two lenses and a prism on to the film. The width of the image is equal to the lead of the screw or one-hundredth of an inch, and its height is two-thirds of its width. As the light passes through the film it falls on the photo-electric cell, which is inserted into the film holder. With a change in shade of the film, at the point where the image is focused, the intensity of the light on the cell also changes.

As a means of changing light energy into electrical energy a photo-electric cell is used. It consists of a long evacuated tube, coated internally wtih a potassium cathode, and containing a metallic ring shaped anode. A potential of approximately 100 volts is maintained between the two elec-

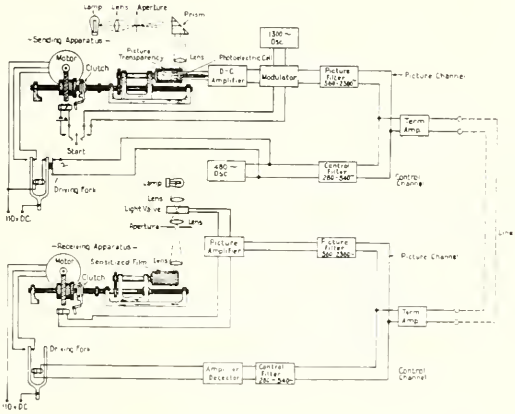


Diagram of the telephotograph apparatus showing the external connections between the various units.

trodes. Light passing through a window, falls upon the cathode, causing it to give off electrons. The number of electrons given off varies directly with the intensity of the light that falls upon it. These electrons are attracted to the positive anode, causing a small current flow, about .2 micro ampere. Thus, a change in the density of the picture produces a change in the photo-electric cell current flow. Some of the advantages possessed by the potassium photo-electric cell, over the selenium cell, are the absence of dark currents, and a lack of electrical inertia. This makes possible sharp clear pictures.

Current from the photo-electric cell, is run through a high resistance, to give an appreciable voltage drop, and sent through two stages of resistance coupled, vacuum tube amplification. The use of inductive or capacitive amplification is not possible in this case because the frequencies vary from a few hundred cycles per second to almost zero or direct current. Inductive or capacitive amplification would not operate on direct current. Resistance coupled amplifiers have an added advantage in that they amplify all of the frequencies equally.

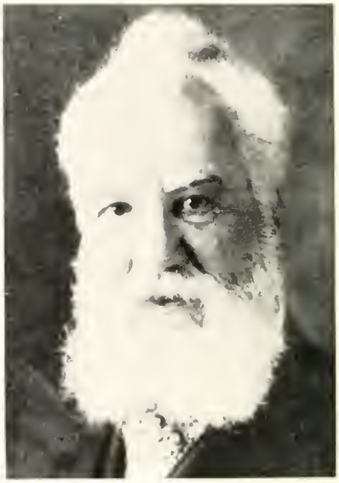
A vacuum tube oscillator, tuned to 1300 cycles, produces the carrier wave that flows over the lines. The output of this oscillator and the amplified output of the photo-electric cell amplifier are both impressed on the grid of a modulator tube, resulting in a 1300 cycle wave, modulated by the photo-electric cell current. To eliminate any stray frequencies or harmonics, a filter is provided at the terminal and then a final amplifier boosts the current still higher.

In order that the light and dark currents may be of the proper value so as to keep the picture the proper shade, a test detector is provided. It compares the value of the output current both light and dark, and provides a means of adjustment.

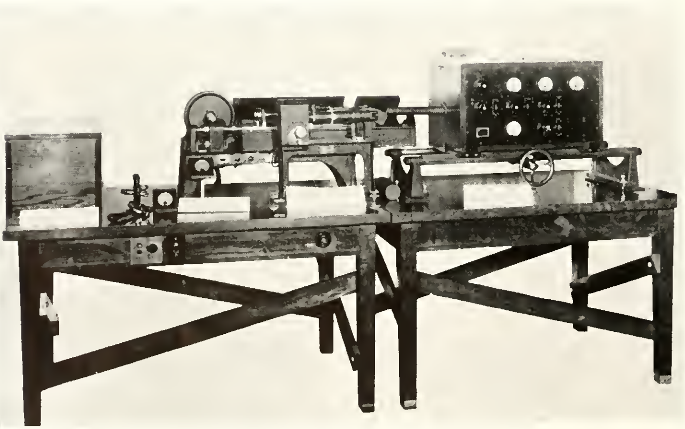
On long distance telephone circuits a certain amount of attenuation or loss of current strength takes place. To compensate for this loss vacuum tube repeaters are placed along the line at intervals of approximately 50 miles on cable and 150 miles on open wire. Repeaters are inductive coupled amplifiers, with a low amplification, and are used on all long distance telephone lines.

At the receiving end, the incoming currents are again boosted by a terminal amplifier, and a filter is provided to separate the modulated 1300 cycle wave from the 480 cycle wave that also comes over the wires to control the motor speed. Two stages of transformer coupled amplification amplify the 1300 cycle current and it is terminated across the light valve.

As its name implies, the light valve acts as a valve or check on the amount of light passing through it. The amount of light it will pass varies as the strength of the current through it. It consist of a thin ribbon of duraluminum, one and one-half inches long, held in mechanical tension in a strong magnetic field of constant strength. At rest, the face of the ribbon obstructs the passage of a beam of light through an aperture on to the film. If, however, a 1300 cycle current flows through the ribbon, a force is produced that causes it to vibrate 1300 times a second. As it vibrates, part of the aperture is opened and light is allowed to pass. The greater the magnitude of the current, the greater is the displacement of the ribbon, and the more light passes through the aperture.



Actual telephotograph of Alexander Graham Bell sent over long distance wires.



Transmitting apparatus of the telephotograph machine The large box at the right is the amplifier and modulator. The fork is located in the box to the left and the picture goes on the holder.

The source of light is a small, high powered lamp of constant light intensity. Three lenses guide the beam through the light valve and focus it on an unexposed film. This film is of the same size as the transmitting film, and is rotating at the same speed and in the same manner. The image of the light on the film is of the same size as the original image and traces a series of adjacent lines just as the transmitting image does. When the film is developed, a negative of the original positive results.

Motors of the phonic wheel type are used to drive both the sending and receiving machines. The rotor of the motor is iron and has ten teeth, and the stator is composed of four magnets. The current applied to the magnets is one that pulsates in value. If the motor is brought to a speed of such value that when a tooth is approaching a pole, that pole becomes magnetized, and when it is leaving the pole, it loses its magnetism, a pulsating torque is developed tending to turn the machine. A heavy flywheel, containing mercury, keeps the speed constant.

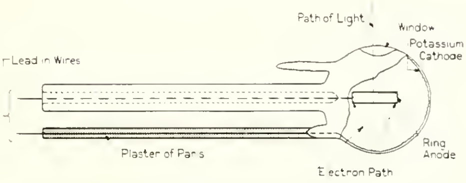
A large tuning fork, which vibrates with a natural frequency of about 60 cycles per second, controls the speed of both the sending and the receiving motors. This fork is located at the transmitter and there is a similar fork at the receiver. The control fork, like a buzzer, is kept in vibration by means of two magnets, the fork interrupting the current through them. Two other sets of contacts make and break connections when the fork is in vibration, one of which interrupts a 110 volt D. C. current through the motor, causing it to turn with a speed depending on the frequency of the fork vibrations. The other set of contacts short circuits the output of a 480 cycle vacuum tube oscillator which, passing through a filter and terminal amplifier, goes out on the line. Instead of a steady 480 cycle current being sent over the line, there is a 480 cycle current interrupted 60 times a second.

At the receiving station the interrupted 480 cycle oscillations are amplified by the terminal amplifier and directed into the proper channel by the control filter. They are passed through another amplifier and then into a relay. As the spurts of current enter the relay, it is caused to operate in synchronism with them, making and breaking a 110 volt D. C. circuit that drives a receiving fork, of the same type as the sending fork, in synchronism with it. A local 110 volt circuit is interrupted by the local fork contacts and drives the local motor at exactly the same speed that the motor at the transmitter is being driven.

It is absolutely essential that the two machines be started at the same instant if the picture is to be continuous. To insure such a condition, the operator at the sending station starts both machines together. Communication is first established by telegraph and then the transmitter sends the pure 1300 and the interrupted 380 cycle waves. Each man then brings his synchronous motor to speed by means of a hand crank. At the receiving station is a start key, which when operated, changes the picture amplifier into a detector by a change in grid bias. At the same time the output of the tube is transferred from the light valve to a relay that operates the clutch on the motor shaft. The 1300 cycle carrier operates this relay which, by means of a local magnetic circuit, holds back the clutch. When ready to start the operator at the transmitter presses a key which releases his own clutch and at the same time short circuits the 1300 cycle wave for an instant. This short opens the receiving relay, causing the clutch to be released by the magnet. A powerful spring engages the clutch so that it turns the film holder. This takes so little time that the two film holders start practically together.

The 480 cycle control system has the disadvantage that modulation often occurs between the picture carrier wave and the control oscillations, causing bands to appear on the picture. If the strength of the 480 cycle wave is considerably reduced, this modulation is eliminated, but in so doing, the effect of noise energy increases and results in poor control. To eliminate such difficulties an independent system, called constant frequency control system, has been inaugurated at some of the stations.

Various line conditions have different effects on transmitted pictures. A level change, that is a sudden change in the strength of the line current will cause a picture to change its shade. One part of the picture will be of a deeper, darker shade than the other. Noise will cause spots and streaks, and poor synchronism will give a rugged outline. Modulation of the picture carrier and the control carrier will cause a series of alternate light and dark bands across the picture.

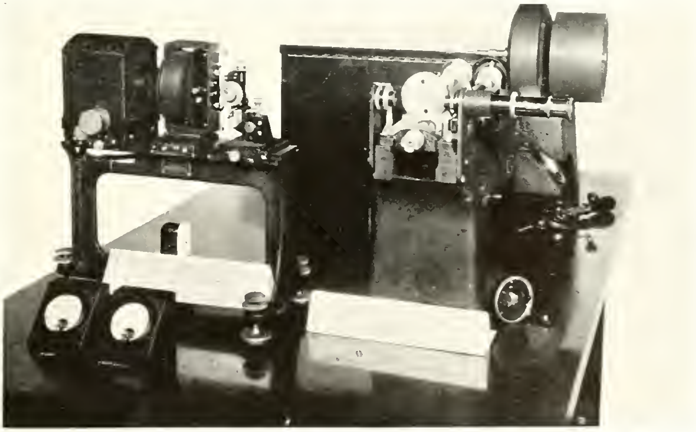


Cross-section view of the modern photo-electric cell.

Telephotographs are used, for the greater part, by the newspaper trade. Photographs can be sent swiftly and cheaply to all station points. Almost every daily paper has at least one or two telephotographs in it, although they are not always so labeled. Another large part of the business is in the form of brokers bond issues. It is necessary to have the advertisement or announcement in the papers of different large cities, exactly the same. Time is a valuable asset and instead of telegraphing lengthy and minute instructions, the ad is photographed and sent over the telephone lines. Pictures of criminals and their fingerprints can be quickly spread over the entire country.

By co-operation with the telegraph companies, arrangements have been made to send personal telegrams, that is telegrams in the original handwriting, at only a small increase in cost. Personal telegrams of this type are very popular for greetings and personal messages. Another use of the written photogram, as it is called is in financial dealings. A man can send to his bank for money under his signature, or identification can be proved by handwriting. In times of war the apparatus should prove invaluable for transmitting maps and papers. Technical drawings and circuit diagrams as well as legal documents can be successfully transmitted. X-Rays are often sent between cities when a doctor wants the diagnosis of another surgeon in a distant city. The uses of the telephotography are practically limitless and more and more applications will undoubtedly come up.

While the mechanism for the transmission of photographs over extensive distances has been primarily developed for use on telephone lines, it would probably be suitable for the transmission of photographs by radio if atmospheric conditions were such that steadiness of transmission and freedom from interference could be assured.



Receiving apparatus of the photo-electric cell.

SPARK PHOTOGRAPHY

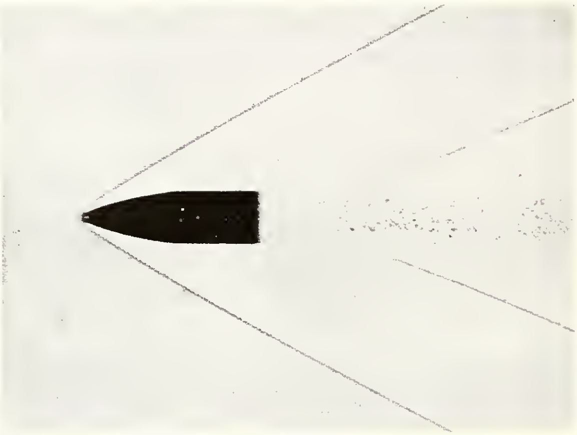
By Herbert E. Stier '30

Student in the Department of Electrical Engineering

PHOTOGRAPHY is an art that plays a very important part in the life of the engineer and the people working in the sciences. The doctor uses it in the taking of X-rays of the patient, the metallurgist in micro-photography of metals, the electrical engineer in the study of phenomenon reproduced on the oscillograph, and the astronomer in taking pictures of the heavens. There is really no branch of the sciences in which photography is not used.

Spark photography is a type of photography using no lenses or shutter, the timing being controlled by the discharge of an electric spark. Its application is for very high speed phenomenon. As the record obtained on the plate is not an image but a silhouette of the object, it is necessary that the object be opaque.

The ordinary hand cameras have shutter speeds ranging up to 0.001 second. Some cameras have been built with shutters rated at 0.0006 second but they seldom operate at less than 0.002 second.



Interesting photograph of a .30 caliber 1906 bullet flying through space at a velocity of approximately 2,700 feet per second. The sound waves and air disturbance behind the bullet are clearly shown. This picture required an exposure of one-millionth of a second.

Using a spark as an illuminant, it is important that the timing of the spark be exact. Spark photography has been especially adapted to the taking of pictures of projectiles travelling at high speeds. Taking a picture of a projectile travelling at a speed of 2700 feet per second (that of the present 30-06 cartridge containing a 172 grain bullet) with a photographic plate, 8x10 inches, the projectile is in front of the plate only 0.0003 second. Thus, if it is desired to photograph the projectile within an inch of a predetermined position, the timing of the spark must be within 0.00006 second.

The amount of motion that the projectile will have on the plate will be in accordance with the time the spark is in operation. If the motion is to be arrested within one-sixteenth of an inch for the above considered projectile, the time of the exposure should not exceed $2x10^{-6}$ second.

It might at first seem impossible to time a spark to this degree of accuracy but it has been done by Philip P. Quayle, chief physicist of the Peters Cartridge Company. It is through his courtesy that I am able to describe the instruments and the pictures.

To obtain a properly timed spark of suitable character, it is necessary to have a machine to generate a very high voltage, a means of storing such voltage, and such apparatus to regulate the voltage and release the energy at the proper time.

In the equipment of the Bureau of Standards, the generating device consists of a motor-driven influence machine having two revolving disks 17 inches in diameter. The storage of the energy is accomplished by using a Leyden jar having a capacity of 0.024 mf. The voltage is regulated by a dynamometer, or a potential limiter, with a switch that disconnects the condenser from the generator when the voltage across its terminals reaches a value determined by the setting of the potential limiter. The release of the spark is obtained by an electromagnetic switch which closes a trigger spark-gap and an auxiliary device which times the operation of the switch with respect to the object to be photographed. The auxiliary device takes different forms depending upon varying conditions.

The following taken from Scientific Papers of the Bureau of Standards No. 508 describes the apparatus fully. This paper is called "Spark Photography and Its Application to Some Problems in Ballistics," by Philip P. Quayle.

"The potentional limiter starts the mechanism which disconnects the condenser from the charging circuit at a definite voltage. It consists of a fixed pair of spheres, a pair of fixed vanes, and a pair of moving vanes, the centers of which are all at the same distance from the axis of rotation. The moving vanes are supported by a central spindle on which is also carried a cam which operates through a lever to close the make circuit mounted on the supprting pillar. The two brass balls are connected by a rod which is insulated by a pyrex tube. The vanes are all conductively connected and may be rotated about the spindle as a center, thus giving a coarse adjustment of the potential at which the apparatus is set to function. The moving vanes are normally about 1 cm. away from the fixed ones, and are restrained from swinging too far by a small stop attached to one of the stationary vanes.

When the potential across the terminals of the potential limiter is high enough, the repulsive force between the vanes and the attractive force between the spheres and the moving vanes operate to rotate the spindle. The rotating of this spindle closes the circuit mounted on the supporting pillar by means of the cam and lever. The friction disk and spiral spring located at the bottom of the vertical spindle serves to adjust the torque on the system, thus changing the potential at which the apparatus functions.

The condenser switch performs three distinct functions. It disconnects the condenser from the influence machine, short circuits the latter, and closes a signal light circuit which indicates that the switch has operated. The movable arm is cocked against a spiral spring, located under the upper plate of the apparatus, and held by plunger of an electromagnet which engages a catch on the arm. In this position the side of the influence machine which is not grounded is connected to the corresponding side of the condenser. When the potential limiter functions the solenoid is energized, thus retracting its plunger from the catch on the rotating arm. The arm under the action of the spiral spring promptly rotates through an angle of 90° to a position in which the condenser is disconnected and the terminals of the influence machine are short circuited. This is done to prevent the building up of potentials which would cause sparking and might easily fog the plate. The surges which such a discharge would induce in the spark circuit might easily cause a premature exposure or even a secondary spark, either would impair the results obtained.

One other feature of this switch is worthy of note. Since it functions when the apparatus is in readiness for the taking of a photograph, some means is necessary to convey this information to the operator of the gun or to actuate a solenoid which will itself attend to the firing. At the back of the upper plate is a small buffer, for arresting the motion of the arm as it swings from the charging to the short-circuit position. This buffer also serves to make a circuit which may be used to light a signal lamp or to actuate an electromagnet which will fire the piece.

Spark photograph showing the leading pellets of a shot striking the clay target in mid-air.

The switch by which the photographing spark is set off consists of an aluminum arm carrying at its end a small cross-bar which is cocked by means of a spiral steel spring, adjustable in tension. In the cocked position the arm is held below the two brass balls of the spark gap by a catch on the modified relay. Upon the release of the arm by the relay catch, the cross bar is carried through the gap between the two brass balls. In the system here described the change in length of spark gap which is involved in triggering the spark is greater than in the other system. This makes possible the use of higher potentials and consequently a stronger photographing spark is assured. The tip of the switch arm and the relay catch are hardened, and adjustments are provided for regulating precisely the amount of the switch-arm tip which the relay catch engages.

The interval between the breaking of the relay coil circuit and the actual release of the switch arm is approximately 0.0015 second. With the spiral spring adjusted to maximum tension the spark occurs 0.0033 second after the arm is released. The total lag for this adjustment is, therefore, 0.0048 second. The advantage of using the crossbar between two spheres to close the trigger gap over using one sphere only is that in the former case the gap is closed twice as fast for the same angular speed of the arm. Perhaps the most important feature of this switch is the wide adjustment in the time interval required to close the trigger gap which is secured by changing the tension on the spiral spring. At present the range extends from a minimum of 0.0048 second to 0.1 second or more. The minimum could, of course, be reduced still further by stiffening the actuating spring. It is well to keep in mind, however, that in general, the

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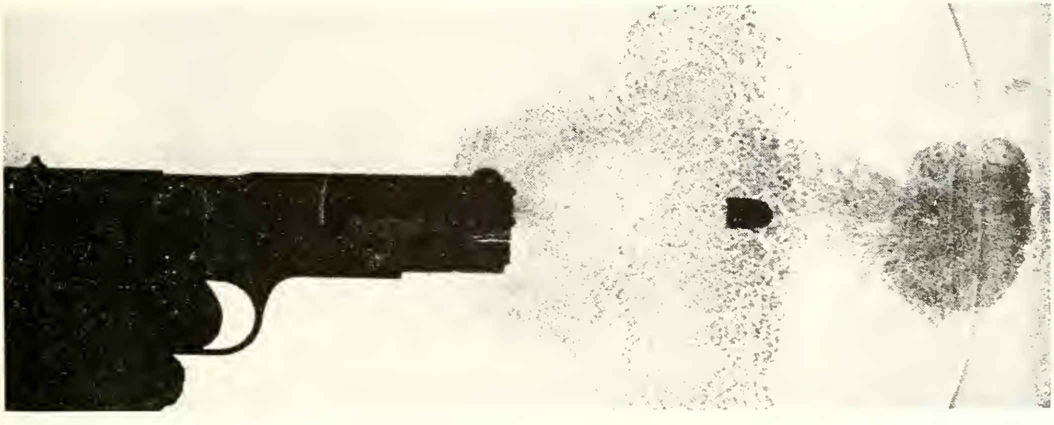
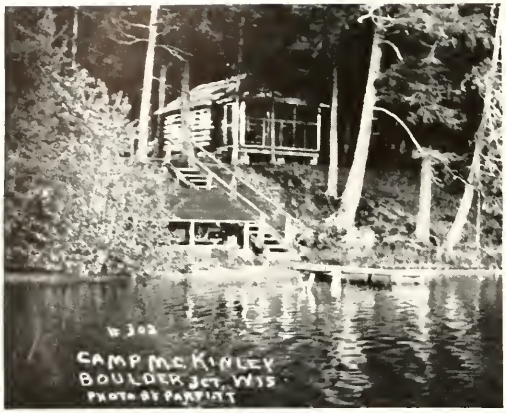

This spark photograph taken in one-millionth of a second shows the bullet a little more than three inches out from the muzzle and moving at a speed of approximately 800 feet per second.



A view of Camp McKinley, Boulder Junction, Wisconsin.

Just A Wonderful Day

By John J. Schommer '12

Assistant Professor of Industrial Chemistry

THERE are times when even an engineer revolts at studying cost schedules, flow sheets, production methods, mathematics and physics. So instead of fatiguing your brain with more than trite "Object of the Experiment, Apparatus, Data and Conclusion," let your mind wander from technical things and enjoy a day with me in the great North Woods.

A canoe party one afternoon, landing at Camp McKinley on Wolf Lake, Wisconsin, where my summers are spent, brought the intelligence that the tigers of the north (muskalonge) were striking on Round Lake. This news set me on edge. Had the Chippewas gone on the warpath I could not have been more excited. Perhaps "Old Silver Sides" could again be enticed to strike my lures. The old devil often outwitted me. Twice that "muskie" was hooked and after a furious battle "hung me" in a sunken tree top and escaped. At least a dozen times in years past the big brute followed my bait almost to the canoe. He would swim leisurely along and then it seemed to me on his stop that he would turn his tail and point it to his nose as he sank from view. That afternoon I drove thirty miles to procure big suckers about twelve inches long to be used for bait. Tackle was overhauled and the pack was filled by lamp light.

Little sleep was indulged in that night. Everything disturbed me. The bullfrogs never croaked so loudly. The hoot owls seemed to be trying to outdo one another with their "Hoot! Hoot! HootOOOH!" A distant pack of wolves with their cries sent the shivers up and down my spine as their yaps came faint or loud in their chase. I wondered whether some poor little bunny or a deer was the quarry. Now and then the flop of a bass set me speculating as to its size when it hit the water with a resounding splash in the mad rush for its kill in the rushes. The sob of a loon way down the lake made me feel melancholy. Crackling brush set me wondering what wild animal was running in the woods. Then Mr. Skunk made his debut with his never failing familiar odor. So the night wore on with sleep in fitful starts and twists.

It was just dawn when the fire in the stove was lighted. Finally my boots were laced and I stepped out of the cabin. A startled buck sprang out of the lake clearing a dead fall in a beautiful leap and ran down his runway. Disturbed bluejays sent the echoes flying. Some red squirrels added their chatter to the chorus. From down the lake came the soprano "Bee a wee! Bee a wee!" of a loon. His flying brethren answered with their crazy laugh. The dew filled air was laden with delicious odor of pine, coffee and the smoke from wood fire. The fragrance of the coffee sent me to the kitchen on a trot. Here with the guide we "put away" some eggs, flapjacks, doughnuts and coffee. Then with pack and equipment we "hit the trail."

We paddled across Wolf Lake and swung into the well beaten path of Little Bear Lake. The trail never looked more beautiful. The hard and soft maples splashed the heavy green of the pines with reds and scarlets. The oaks added their golden brown. Throughout the journey red squirrels scampered from the hazel brush. The brakes were golden brown but the rock and maiden-hair ferns in big beds were just as fresh and lovely as in June. They still defied Jack Frost's paint brush. Interspersed through the forest were wild asters, wild daisies and black-eyed susans. Big clusters of red berries hung in the mountain ash. Redder still were the sumac on the hillsides. Now and then a deer was jumped and several coveys of partridge were flushed. At one place the ground was all dug up. On examination the foot prints of a bear were found.

"Jawn" J. Schommer in an informal pose.

A nook in Little Bear Lake — one of the many beautiful spots.

So the shores of the Little Bear were soon reached.

The shores of this lake were resplendent with red, yellow, scarlet and gold through which towered the cathedral spires of the big pines. The loons were busy with their cries as soon as we reached the lake. A big fish-eagle was soaring about looking for its prey. As we set out for the Round Lake Trail we saw several wary mink along the shores and numerous muskrats. As we landed a porcupine was padded for some quills for hat decoration. A beaver dove with a loud splash as he hit the water with his tail to warn his comrades of impending danger. Just to the right of the Round Lake Trail a beaver dam was examined and we marveled at some big poplar trees that had been felled by these nocturnal animals.

We were soon under way again and enjoyed much the same scenery as encountered on Little Bear Trail. Eventually the canoe was put into Round Lake Creek and away we went for the lake through a winding creek lined with tamerack, alders and bushes of all sorts. Blackbirds abounded and an occasional wood duck was scared into flight. Several big blue herons squawked their disapproval of us as they flapped their awkward way in flight. One American bittern poked his bill perpendicularly in the air trying to imitate a reed and sat immovable until water was splashed on him. As we paddled into the lake a big flock of black mallards rose and flew to another lake.

Here we were at last. A bait was soon put on the hook with the customary harness to prevent the sucker from tearing off with the casts. Straight across the lake we paddled to "Old Silver Side's" favorite nook. A beautiful one it was. If ever I am to be a muskie there is where my home will be. Cat-tails and reeds line the shore. Beautiful beds of pond lilies bedecked the surface while deep patches of thick muskie weeds grow in every direction on the bottom, affording magnificent hiding places for his highness.

Slowly the guide put me just off the outer beds and away the sucker was sent flying. After many casts a small muskie about six pounds slashed the bait to pieces. But the big brute was not to be enticed. We left his haunt and returned several times, but no avail. Nor could we locate anything in the morning but several small ones which we did not try to catch but pulled the bait away. Several walleyed pike were caught on a trailing hook the guide tended. These were for lunch. Finally with the sun in midsky we landed at a spring for the noonday meal.

The fire was soon crackling from pine knots and cedar. Frying bacon and fish started to sizzle. These with scrambled eggs, French fried potatoes, coffee, doughnuts and cookies filled us to the bursting point, but at that there was room enough in us for some blue berries picked by me. What a setting and how often my mind wanders back to these shore meals. Big pines for a canopy, a crackling fire and the rustling wind for music with now and then a solo by some bird. A roaring appetite satisfied. Then the old pipe and the stories of the big ones that got away. Then a nap on balsam boughs whose delicious fragrance I can smell right now. So the afternoon was spent until late when again the muskie bait was sent awhirling. The swallows, night hawks and martins were circling about and it looked as if we were not even going to see the prize we sought.

Suddenly a terrific splash rent the water asunder. "Old Silver Sides" shot out of the water as my bait hit just at the edge of a patch of deep muskie weeds. I stopped the bait instantly. Oh! what a sickening feeling at that moment, wondering if only lulled by curiosity the fish rose or whether in savage hunger he struck. A few tense seconds that seemed hours and then the line began to move. He has it! He has it! The guide and I now were tense but our minds instinctively turned to impediments that might mar the successful termination of the battle yet to come. Will he go through the lilies or through the muskie weeds? Or worse yet, will he entangle me in that old sunken tree top I swore often to dredge

(*Continued on page 36*)

"Old Silver Sides" favorite nook.

ARMOUR
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LAFAYETTE, WE ARE HERE

By R. L. McInerney '30

Student in the Department of Electrical Engineering

THE ninth annual convention of the Engineering College Magazines Associated was held at Purdue University, Oct. 31, Nov. 1 and 2. The invitation to be guests of Purdue University was accepted by eleven members of the staff of the *Armour Engineer*. This proved to be the largest visiting delegation ever sent to an E. C. M. A. convention. It was decided to travel by auto in order to keep down expenses and to enable the majority of the members to benefit by the convention. Wednesday evening, Oct. 30, the party started for West Lafayette in three cars. The trip to the convention that night proved to be most interesting; one car arrived on time with no trouble at all, another arrived eight hours and seven flat tires later, and the third fell by the wayside with a set of stripped gears—forcing two of the staff to proceed by bus.

Thursday morning found the entire party distributed at various hotels about town, but at the appointed time, despite the wet weather, all met at convention headquarters, where they registered and where each received a badge bearing his name and the name of his school. A short time was devoted to the privilege of meeting delegates from the seventeen other engineering college magazines who were present at the roll call on the opening day. The first session, which was called to order by Mr. Willard Merrihue, the national chairman, was devoted to roll call, and to the reading and discussion of reports. When all discussions were ended, it was announced that the group picture was to be taken, and the delegation stepped out into the rain and patiently posed for a picture. The wet clothes and dampened spirits which incurred were soon forgotten, however, at the group luncheon which was held at a comfortable tearoom not far from the campus. Here the members of the convention made good use of their time in doing justice to the food and participating in the active discussion around the table.

The Armour Engineer's delegation to the E. C. M. A. Convention.

The afternoon session consisted mainly of the chairman's annual criticism of magazines, and quizzes on standards of practice and on advertising makeup. The criticism proved to be the most interesting of the events on the afternoon program as the chairman proved to be very outspoken on every magazine in E. C. M. A. Each magazine was reviewed, attention being called to its demerits so that they could be corrected, and to its merits so that they could be followed. Following the quizzes, the annual E. C. M. A. informal banquet was held at the Home Economics Banquet Room on the campus and was arranged and served by home economics students of the university. The delegates found that the places were assigned according to some unknown system, but fortunately most of the Armour students were seated at one table. Between courses each man was requested to stand up, introduce himself, and to make some short remark about the convention. The word "short" in the request seemed to be of paramount importance so that the entire introduction did not take much time. The Iowa State delegation consisted of quite a few members, and as a result they were requested to render some vocal selection which they did by singing the "Iowa Corn Song" with the help of the entire assemblage. Armour was then found to have quite a good representation, and at the request of the toastmaster was asked for some school song or cheer; the "Armour Fight Song" was put across as good as eleven, loud Armour men could do it. The chairman assured the Armour delegates that they were not able to make much noise so they naturally assumed it to be music and felt complimented. The address of welcome was tendered by Dean A. A. Potter, Dean of Engineering at Purdue University, and the response was given by the National Chairman. This was followed by talks by Mr. L. H. Church, Mr. G. W. Morrison, and Mr. G. O. Hayes, all of whom are men of prominence in engineering publications. Mr. G. O. Hayes concluded the speaking by an interesting talk on "Engineering Journalism."

After the banquet the boys returned to the hotel, where they were now staying, in the hopes of finding some form of entertainment. They reckoned without the habits and customs of small towns, and so were forced to be content with an exciting evening by walking between showers (which seemed to persist)—watching the townspeople attempting to celebrate Halloween and finding interest in an occasional engineering student wearing the characteristic yellow corduroy trousers which are in vogue among the seniors. Having rooms in the hotel situated across the hall from each other afforded possibilities for participation in a few exciting pillow fights, the result of which have not yet been decided in favor of any one room.

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WHY CIVILS STUDY CIVIL ENGINEERING

By Joseph T. Ellman '30

Student in the Department of Civil Engineering

The Civils.

ALL students in the department of Civil Engineering are required to attend, at the end of their Freshman year, the famous (or infamous) summer camp. This session of six weeks in Northern Wisconsin is compulsory, and yet after returning everyone, without exception, wishes they were able to return. According to the general consensus of opinion, the professors and the instrument-man are the really fortunate ones as they are able to return.

The seventh of June, 1929, was a red letter day in the lives of some 32 enterprising and ambitious young men. Some may have been away from home for short periods at a time, others for perhaps a year or so, and some had undoubtedly never been away from home.

The class embarked on their special sleeper and after a hectic 12 hours, arrived in the thriving "metropolis" of Minocqua, Wisconsin. They were then transported to Camp Armour (about 18 miles away) by bus. The potential "hell-raising" Civils then had some food but as it is more commonly called there "grub" or "chow."

The early part of Saturday evening was spent in preparation for the famous Saturday dances at Trout Lake. They were *the* social events of the season. Many a period back at A. I. T. has been wasted by the fellows talking of those good 'ole dances at Trout Lake. The so-called weaker sex were plentiful; coincidentally, they all seemed to be co-eds from the University of Iowa. It was rather comical to watch them try to "kid" the Armour men, but they were not to be downtrodden.

The morning after the night before.

Then came Monday morning with its work. The first few weeks were spent in becoming familiar with the instruments, their various uses, and acquiring accuracy. Many a man spent many an hour trying to "dope" results and wishing that he had been a little more precise in his measurements in the field.

There is hardly any question in the minds of any of the men as to whether or not he received a competent education in surveying. Everything from the care, use, and adjustments of instruments, tapping distances, laying off angles, plane table and stadia topography, latitudes and departures, measurements of polygons, railroad curves, establishment of true meridians, etc., were thoroughly studied.

The second Saturday in camp (after a week's work) was spent in the cleaning of clothes; from Saturday to Saturday thereafter, the number who did wash their clothes dwindled down until on the last Saturday there was no one on the lake for the purpose of washing clothes.

The main casualties suffered in camp were Nelson's infected foot, and when one of the Knuteson's became ill with a cold. Incidentally, the two Knutesons with Shermer (the Deacon) were easily the fishiest fishermen of the student camp. However, the faculty, Professors Wells, Heald, Instructor Jaros, and Instrument-man Hafner were not to be outdone by the above, and the entire camp enjoyed some excellent fish dinners due to their efforts. "Little Essy" Eskonen, the boy who pulled up stumps of trees and then put them back as a sort of daily dozen, cut his foot while swimming and was laid up for a couple of weeks also.

Some of the main attractions were barnyard golf (horseshoe pitching) with Olsen and Hansen as the victors, the Saturday night dances, fishing, rowing, some childish and some serious stunts, and last but not least, the volley-ball contests originated by the famous "Nick and Give" (Giovan and Skoularinas). These contests were hotly contested, with tent No. 7 of Robbins, "Rut" Rutkowski, "Heavy" Rossing, and "Swede" Carlson usually being victorious. There were a variety of card games going, with Professor Heald, Instructor Hafner, "Chief" Reif, and the writer always to be found playing bridge. The five are still argu-

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ENGINEERING NEWS

Welding

More and more industries are making use of the fact, that welded parts are more efficient than the time-honored engineering practice of riveted joints. Probably the most spectacular change from existing conventions was the construction of the new German cruiser, the "Admiral von Spec," a nine-thousand ton displacement man-of-war.

Germany was restricted in her building of a large navy by virtue of the terms of the Versailles Treaty, and had to find some expedient for ample marine protection. Hence, Germany has welded together an armored ship, which will be able to hold her own against an adversary four times the size of this new nemesis of the seas. But what was the basis of this radical change in size without loss of fighting ability? The secret of Germany's surprise was construction of the armored hull. Instead of cluttering up the frame with several million rivets, which are nowhere near 100 per cent in efficiency, the designers of the craft made practical use of an old proverb: That "a chain is as strong as its weakest link."

Because the hull of the "Admiral von Spec" has been welded into one solid piece, it was possible for the engineers to mount on the decks six eleven-inch guns which will permit a salvo of 4000 pounds from the muzzles at one time, without any damaging effect to the ship. Similarly, should one of the 10,000 ton "treaty" cruisers of the type developed by the United States and Great Britain be presented with the same situation, the concussion caused by the broadside would force the plates in the hull to such an extent that the rivets would be sheared off. Hence the vessel would be put out of commission. Another factor which may be considered is the saving of 1000 tons of weight.

Building construction engineers are now dipping their fingers into the problem of all welded super-structures. Conclusive tests were performed before the American Society of Mechanical Engineers concerning actual conditions existing in the field. In the tests run, "I" beams fastened to uprights at each end were subject to the riveting hammer and the welding torches. The demonstration showed that under identical conditions the welded members failed at a loading of 90 tons and the riveted structures gave when only 60 tons were applied. With such results, it does not take an individual with much foresight to appreciate the possibilities of welded superstructures.

Since most of the pretentious skyscrapers are confined to a limited area, it is necessary for those people imprisoned in that area to contend with the noise. The reverberations which issue from the riveter's gun have caused hospital authorities, attorneys-at-law and other erudite souls to give up in despair when the structural acrobats are at work. But, with the welding process in full force the excruciating effect on those in the vicinity will disappear. In fact, during the construction of the all-welded "Sterling Memorial Library" on the campus of Yale University, no one was disturbed by the silent dispatch which marked the completion of this modern building.

Welding truss ridge connection.

It is possible that in another decade riveted joints will be as obsolete as a "one lung" automobile is today.

Power From the Earth

At Lardrello, Italy, a power plant has been developed which uses steam from the earth as its source of energy. This plant at the present time consists of three 2500 kilowatt units. The power developed in this station is stepped to 38,000 volts and then connected with a network of hydro-electric power stations to supply Florence, Pisa, and other cities.

The steam was obtained by drilling wells at spots where natural steam springs were located. The wells are drilled from 200 to 750 feet in depth; the deeper the well the more violent the steam action. The drillers of the wells are of the 9 2/5 second, 100-yard dash type, as sudden blasts of steam, in the process of drilling, come without warning.

At the present time in the area of Tuscany, which is about 100 square miles, twelve wells are in operation. The wells give a total of over 250,000 pounds of steam per hour at slightly less than atmospheric pressure. The steam that is used is brought from the well to the power plant, which is several hundred feet away by a well-insulated pipe.

In the geyser region of this country, wells have been drilled to depths as deep as 650 feet, which have given pressures up to 275 pounds. These wells have been rated as being capable of giving 1500 horsepower each. Up to the present time they have not been used for any commercial purpose however.

Vacuum Shift

A vacuum gear shift for motor cars has been placed on the market. The actual shifting of the gears in the transmission is accomplished by the difference in gaseous pressures in the inlet manifold and the atmosphere. In the device two power cylinders are mounted in back of the transmission on the frame. A valve is located on the steering column, which is connected by means of tubing to the inlet manifold and both ends of the two power cylinders. This valve acts as a control for connecting the inlet manifold and the cylinders.

The power cylinders are connected by push rods or links to a pair of levers mounted on the transmission. The levers are then in turn rigidly connected to shifting forks in the transmission. As the ends of the cylinders are connected to the intake manifold by the valve control, vacuum exists which permits the atmosphere to force the cylinder to move the desired push rod and so shift the gears.

Metal to Take Place of Platinum

A new metal has been developed known as "Konel," by Dr. E. F. Lowry, a graduate of Ohio State University. This new metal is credited with being much stronger than other metals at high temperatures, and can be extensively used in the moving parts of internal combustion engines and similar hot mechanisms.

This new metal was originally developed to be used as a substitute for platinum in the manufacturing of filaments for radio tubes. Since platinum costs $180 an ounce, and this new metal "Konel," only costs a few dollars a pound, it can be readily seen what a tremendous saving is brought about by its use. The life of Konel filaments is approximately ten times longer than other filaments. Tubes using filaments made of this new material are operated 175 degrees colder than tubes with platinum filaments, at which point, they give the same electron emission.

The new metal was found to be harder to forge than steel, and very hard at high temperatures, where most metals lose their strength. Engineers are looking forward to the utilization of this metal for many purposes.

Blau Gas

"Valving off" of the levitating gas of a lighter-than-air craft used to be the method employed by operators, in order to keep the buoyant effect of the ship constant. This was an extravagant way of releasing a gas as rare as helium, which is used in the dirigible "Los Angeles."

The United States Navy devised a condensing system for use on the "Los Angeles" which solved the problem very nicely. Since, gasoline was used as fuel there was a vapor left after the gas had been exploded, which in turn was condensed and placed in storage tanks. As the gasoline was consumed, the storage tanks filled and consequently the "lift" value stayed practically constant. The condensing plant is a large heavy affair which is one of its drawbacks.

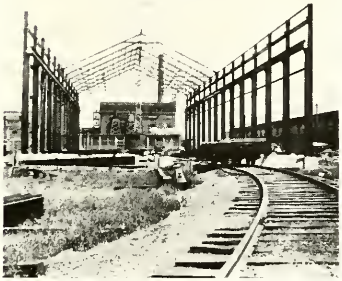
When the "Graf Zeppelin" was put into commission recently, however, the Germans had solved the problem with less intricacies than the Navy Department. Instead of using gasoline as fuel, the Germans produced "Blau" gas which has the same specific gravity as air and it also has a high fuel value. Thus the load is not diminished as the fuel gas is used. The gas is kept in separate balloonettes in the interior of the craft which need no attention and in the aggregate does not weigh the ship down unnecessarily as is the case in the American project.

"Blau" gas is produced by the cracking of oil.

Duralumin

With the development of "heavier-than-air" and "lighter-than-air" aircraft, duralumin has been developed to meet the demands of the industry for lightness and high strength. Duralumin comes in a normal grade which is known commercially as 17S. There are also several modified grades which are designed to meet special demands. The normal composition contains a minimum of 92 per cent aluminum, 4 per cent copper, ½ per cent each of manganese and magnesium, and small quantities of iron, silicon, and other elements.

The properties of duralumin are really determined by proper heat treatment during the process of manufacture. The heat-treatment consists of heating to about 900° Fahrenheit and quenching, usually in a bath of cold water. After this process a change takes place in its properties which is very peculiar for metal alloys containing high percentages of aluminum. After quenching the metal is soft, but its strength and hardness increase at first rapidly, and then more slowly, for a period of four to five days. Hot working followed by cold working either before or after the heat treatment gives added strength to the material, up to a point where the material has been fully wrought.


Completing ox-welded steel framework.

For the normal commercial grade of duralumin, 17S, the tensile strength runs between 55,000 to 63,000 pounds per square inch. On special grades, strengths as high as from 63,000 to 73,000 pounds per square inch are obtained. With a gain in tensile strength the ductility of the metal decreases.

Tramway Spans Half-Mile Canyon

Up in the western mountains near a small town of Camino, California, the largest electric tram or cableway in this country spans a canyon a half-mile wide. This tramway is used by the Michigan-California Lumber Company to transport lumber from a loading point on one side of the canyon to the mill on the other. Because of the heavy loads, high speed, and long distance involved, the installation is one of the most notable of its type.

The tramway is operated by electricity. The electric equipment consists principally of two 225 horse power motors, operated mechanically and electrically in parallel. Momentarily the two motors are able to exert a combined output of 800 H. P. and, for short periods most of this capacity is used. Stopping the carrier at either end is accomplished in four graded steps. After the car is put at rest (a rail car being placed on the carrier) it is "inched" into position so as to line the car rails with the tracks. The motors are located on one side of the canyon from which point the acceleration of the load is controlled. At both ends an operator is stationed to control the "inching" apparatus, to transfer the energy back and forth across to the operators at both ends a red and green light signaling system is installed.

The tramway is capable of transporting back and forth between the two loading terminals, a rail car loaded with a maximum of 24,000 pounds of lumber (a maximum gross weight of 29 tons). The distance between the terminals is approximately 2700 feet, the depth of the canyon is 1200 feet. The maximum speed of operation is 1800 feet per minute, or a little over 20 miles per hour. The carrier makes a round trip in a little over 6 minutes, including 3½ minutes for loading and unloading. The equipment is designed to carry this load continuously at this speed. Four steel cables, each 2 inches in diameter, support the carrier which runs on 32 wheels. The traction rope is of the endless type and is 1 inch in diameter.

The World's Largest Electric Generator

The largest electric generator in the world is located at the Hell Gate Station of the United Electric Light and Power Company, 134th Street and East River, New York City.

This machine has a capacity of 165,000 watts, or approximately 222,000 horsepower. The next largest unit

(*Continued on page 30*)

THE ARMOUR ENGINEER

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ARMOUR INSTITUTE OF TECHNOLOGY

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Make The Armour Engineer the best technical college publication in the country.

> *"Ah, sir, a distinct universe walks about under your hat and under mine—all things in nature are different to each—the woman we look at has not the same feature, the dish we eat has not the same taste, to the one and to the other; you and I are but a pair of infinite isolations, with some fellow islands a little more or less near us."*
>
> *Thackeray.*

THINKING. "In the name of the gods I beg you to think" are the words of Demosthenes and are quoted in the preface of our physics text. Every student knows that there are important courses which, by means of memory work and routine reference repetition, it is possible to pass with good grades, and yet be quite ignorant of the reason behind the entire subject. Mechanical processes, and the acceptance of statements without inquiries as to the how and why, deaden the mind, forming slovenly thinking habits that are hard to shake off.

The other day, a senior was asked by another senior to explain what a new device was and how it operated. The first man expressed great surprise that the other was ignorant of such a well known device, but questioning soon revealed that he knew no more than the man who had asked him. He had used the device, talked of it, and thought that he was perfectly familiar with its action, but when he was called upon to give any positive information he discovered that his knowledge amounted to nothing at all. What would an employer have thought of such an engineer?

THE ARMOUR ENGINEER, the student technical publication of the Armour Institute of Technology, is published primarily for the student body. Its aim is to publish articles, not highly theoretical as a scientific journal, nor of the popular variety, of interest to the average layman, but articles written in the greater part by students, and in a style that students can understand. Articles that the students, as a whole, are interested in and that will help them grasp processes and methods pertaining, not only to their own department, but to others as well. Such articles help to turn out men having a broader outlook and a better engineering point of view.

A few years back the *Armour Engineer*, aside from its technical features, was the only means of publishing college news. Now, in the *Armour Tech News*, we have a paper that very capably takes care of this phase of the work. The *Armour Engineer* still has its important work to do and continues to serve its original purpose.

While the benefits derived from reading technical articles are numerous and well recognized, few of us realize that there are further benefits supplied by the *Armour Engineer*. At least one half of the articles published are written by students of the Institute. These students receive a training in the writing of technical papers and reports that will prove invaluable in years to come. Where term papers fail in benefiting the writer, a published article often succeeds. The knowledge that the paper will be given wide publicity spurs the man on to obtain more positive information, to strive for greater clearness and coherence, and to take greater pains in the entire composition and style. Any technical article submitted to the *Armour Engineer* by students will be considered, and if it contains the necessary merit will be published.

MONTHLY. As a whole, the *Armour Engineer* ranks high among similar magazines in editorial content, in make-up, and in most of its features. The question has been asked us, "Why does a magazine of the type of the *Armour Engineer* remain a quarterly?" Other publications that we consider our inferiors, younger magazines, have changed to monthlies while in financial conditions that cannot be compared to our strong present state. While all this has been going on we have been watching these changes and yet retained our former status. Why? The reason is financial. Never has the staff been able to change to a monthly and make expenses without raising the one dollar and a half blanket tax.

If any need is felt for the presence of the *Armour Engineer* as a quarterly, there is an increased need for it as a monthly. All its advantages, the student engineering knowledge acquired reading, experience gained editing it, favorable publicity obtained by it, can all be doubled by changing to a monthly. Certainly this is well worth while. It would allow competition on an equal basis with other similar college publications.

The present staff intends to make an investigation. If the transformation is impractical, nothing will be done; but if there is any chance of changing over, the staff will do all in its power to accomplish the change.

INVENTION AND PROGRESS—Most basic inventions and discoveries were made in prehistoric times by men whom we call savages or barbarians. The list is long: the club, the spear, the lever, the trap, the net, the fish-hook, the needle, the sling, the bow and arrow, the boat, the sail, the rudder, the wheel, the plow, fire, cooking, spinning, weaving, the making of pottery and bricks, and the smelting of metals.

By such means as these man has raised himself far above the rest of creation and has obtained dominion over plants and animals, land and sea and air.

These inventions have been with us so long that the memory of man runneth not to the contrary, and it is impossible to realize what they must have meant to the people who first used them. Before the use of fire, men ate their food raw. Before they used clubs and sharp sticks, they had to fight, with hands and teeth, an unequal warfare against the beasts, or to take refuge in flight. Before the distaff or the needle, only rude plaiting was possible and cloth was unknown. Before the fish-hook and net, men had to catch fish with their hands, or pick them up along the shore. Before the boat, the keel, the rudder and the sail, navigation was impossible. The wheel and the cart greatly aided transportation and commerce, although pack-animals, including man, have carried burdens from the earliest times until the present day. Wild animals were probably first domesticated as pets, later as cattle, beasts of burden and barnyard fowl. Pottery and bricks revolutionized cooking and building; the smelting of metals gave man tools and weapons of bronze and iron in place of wood and stone.

But the greatest of all discoveries was economic: It was the discovery of the fact that a man could produce more than enough for his daily need, and thus have a surplus to be used tomorrow; and also, that he could exchange some of his surplus to some other man, each man profiting by the exchange since each gets things he needs in place of those he can easily spare.

IS YOURS the type of mind that reads the editorial page? It would be interesting to make a survey of our readers among the student body and find out how many ever glance through the editorial page. Probably twenty percent read some of them. A good deal more would probably cover the entire humor section.

FRESHMEN, sophomores, and juniors, with or without journalistic experiences, who wish to work on the staff of the *Armour Engineer*, see the editor at your earliest convenience.

KEEP SCRAPPIN'

When you're sick as the deuce, and you think, "what's the use?"
And you're tired out, discouraged, afraid;
And you keep asking why they don't let you die
And forget the mistakes you have made;
When you're chuck full of pain and you're tired of the game,
And you want to get out of it all—
That's the time to begin to stick out your chin
And fight with your back to the wall!

When you've done all you can to scrap like a man,
But you can't keep your head up much more;
And the end of the bout leaves you all down and out,
Bleeding, and reeling, and sore;
When you've prayed all along for the sound of the gong
To ring for the fight to stop—
Just keep on your feet and smile at defeat;
That's the real way to come out on top!

When you're tired of hard knocks and you're right on the rocks,
And nobody lends you a hand;
When none of your schemes, the best of your dreams
Turn out in the way you'd planned;
And you've lost all your grit and you're ready to quit,
For life's just a failure for you,
Why start in again, and see if all men,
Don't call you a MAN through and through!

—*Esty Quinn, in "Progress."*

The object of the education . . . is to assist human beings to become themselves. They cannot become themselves without an effort of mind and will, and the discipline by which that effort is stimulated and guided is education. Because they cannot become themselves in isolation from their fellows, education is a social thing. Because their fundamental human affinities are more important than individual differences, education is the witness to equality. Because their complete development involves not blind or unreasoning obedience, but their intelligent co-operation in purposes which they themselves approve as good, education is the foundation of democracy. Education is, in short, the organized aid to the development of human beings in a society.—Report of the Archbishop's Committee.

THE number of different fields in which men trained as engineers find themselves after graduation is constantly growing. Heretofore, a graduate of an engineering school had before him the prospect of manipulating slide rules, digging facts out of handbooks, or superintending a construction job. The inherent qualities of an engineer, however, make him well adapted in other fields, such as salesmanship, politics, finance, and even journalism.

Journalism, and especially industrial journalism, is a field that very few engineering graduates think of as a possible life's work, and yet the future for anyone with an engineering training and a knack for writing in such a field is very great. Every industry has one or more periodicals containing news, advertisements, and articles pertaining to that industry. The editorial policies and management of these magazines have to be directed by a man who has a technical knowledge of the particular industry, an ability to think clearly, and an ability to write in clear concise language. An engineering training furnishes these requirements quite satisfactorily.

Many engineers find themselves in the field of finance. The largest corporations of today owe their financial success to engineering improvements. The engineering and financing are so closely related in such organizations that a man with engineering training, as well as financial insight, is the man best suited to dictate what should be done in many of the financial situations that face a large corporation.

It is only recently that engineers have participated to any extent in politics. The most notable example of an engineer in politics is, of course, our President, Herbert Hoover. And why shouldn't an engineer, with his knack in handling men, his practical way of thinking, and his ability to reason out cause and effect, be the head of a governmental body? The country needs such men to run its government in a scientific businesslike manner in order that it may keep up with the vast strides made by private enterprise.

The engineer-salesman is becoming quite common as a need for such a man is becoming more apparent to industry. A man with a knowledge of engineering fundamentals is the one best suited to demonstrate to a prospective customer the advantages of his product. Often the customer is himself an engineer, and in order to sell to him, the salesman must be able to talk the engineer's language.

With industry ever finding new fields in which engineers may work, the gloomy prospect of always having to bend over a drafting board or losing oneself in some mediocre job is being displaced in the minds of engineers by the idea that they may really be a power in the world.

AWARDS. The *Armour Engineer* was presented with four awards at the Ninth Annual Convention of Engineering College Magazines Associated. Recognition of merit is shown yearly by these awards, twenty-one college magazines competing. Our cover design received first honorable mention and our illustrations second honorable mention. The other two awards vouch for the quality of this page; a first honorable mention is for general editorials, and the other, a third place was awarded the single editorial "Engineering" in the March issue. Credit for these awards goes to the staff of last year and they should be congratulated on the quality of the work they published.

COLLEGE NOTES

Light's Golden Jubilee

An assembly, in honor of Thomas A. Edison and celebrating "Light's Golden Jubilee," was held in the Mission October 21. The orchestra played a song written for Edison by George M. Cohen. Mr. Raedemaker, of the General Electric Co., spoke on the life of Edison, who has been rightly termed the "electrical wizard."

Mr. Raedemaker, in his talk, told many amusing and interesting incidents in the early life of Edison that are not commonly known. At the early age of fourteen, Edison showed his capacity for work and his remarkable genius when he wrote, edited, printed, and sold his own newspaper on trains running between two railroad stations. At the same time he operated his own chemical laboratory in the baggage car.

At the conclusion of this talk, President Raymond suggested that the Institute send Edison a telegram congratulating him on his great work. This was heartily applauded by the entire assemblage.

Armour Tech Rifle Club

The enthusiasm, which animated the members of the Armour Tech Rifle Club some four years ago when under great difficulties this Club was founded, continues to inspire the expert and novice riflemen.

This year's membership totals forty. During their spare time, these members are found practicing on the rifle range. The club has a permanent range now, at the 124th Field Artillery Armory, 34th Street and Wentworth Avenue. Permission has been granted for pistol firing in addition to rifle shooting.

Due to lack of suitable hours when range officers could give instructions to those firing, a new plan has been adopted in the form of a class. This rifle marksmanship course has been instituted by the president of the club, Herbert Stier, who is a graduate of the army course in marksmanship and who is qualified as an instructor in such. In his efforts, he is aided by an expert marksman, who is a member of the state rifle team. Every Friday afternoon this class is called at five o'clock. A new topic or phase of the game is explained at each session.

A number of local and telegraphic matches are now being scheduled. The first team will shoot in these matches. Two or three teams will be organized as soon as a sufficient number of records have been fired by all of the members. With a handicap for the best team, keen inter-team competition is effected and at the same time promotes the progressive members to a better position on the team.

The staff of officers who are responsible for this year's organization of the Armour Tech Rifle Club are:

President, Herbert Stier.
Vice-President, Louis Statkus.
Secretary, Stephen Janiszewski.
Treasurer, George Kohout.
Sergeant-at-Arms, Hiram Montgomery.
Range Officer, Adair Hess.
Business Manager, George Heller.
Faculty Advisor, Professor Mangold.

OUR VARSITY CAPTAINS

Basketball

W. King Simpson, '30

Armour's basketball team will be piloted this year by W. King Simpson, a senior in the department of chemical engineering. He was born May 23, 1908, in Chicago. Simpson's athletic activities started early, and he had made quite a name for himself while still in high school. He was captain of the Carl Schurz basketball team during his last year there, after serving on the team for three years. The fact that he was the Daily News' choice for center in 1925, showed that his playing was far above the ordinary. He was also on the baseball team at Schurz for three years. He was a member of the 1924 team that were champions of Chicago and New York. His popularity at high school was evidenced by the fact that they elected him president of his senior class.

W. King Simpson.

It was only natural that on coming to Armour, Simpson would keep up his activities in athletics. He has been a member of the basketball and baseball teams ever since starting here and has won two letters in each. His work as pitcher on the baseball team was the talk of the school last spring. During last year's basketball season, King led the Armour cagers in scoring with 86 points. He has a deadly eye for the basket, and his floor work would delight any coach. Much can be expected of the team with Simpson as its leader in the coming cage campaign.

Simpson is a member of Theta Xi fraternity, the Armour branch of A. I. Ch. E., and is president of the Armour Tech Athletic Association.

A. I. Ch. E.

The A. I. Ch. E. held its first meeting October 15. The following officers were elected:

J. Tarman, '30, President.
F. Attwood, '31, Vice-President.
M. Fiala, '31, Secretary.
I. G. Katz, '30, Treasurer.
J. Cavanaugh, '32, Sophomore Representative.

The society is planning to make this year a banner year. Many plans have been made for interesting speakers from the chemical industries. Preparations are being made for a smoker in the near future.

Eta Kappa Nu

A large delegation from Delta Chapter went to the National Convention held at Urbana, November 7, 8, and 9. The convention this year was especially important as it celebrated the 25th anniversary of the founding of E K N at the University of Illinois. There were many interesting meetings, elaborate dinners, and finally the Army-Illinois football game to entertain the delegates.

A smoker was held on October 28 in the Chapter rooms for prospective pledges.

The officers this year are:

Frank Zimmerman, President.
Jack Dollenmaier, Vice-President.
Marvin Tennyson, Recording Secretary.
Russel Southwick Corresponding Secretary.
F. H. Bigelow, Treasurer.

Phi Kappa Sigma

With the beginning of the new school year, Alpha Epsilon of Phi Kappa Sigma found itself well occupied with plans for a banner year.

A whole week before school started, the entire chapter, with a few exceptions, returned to Armour to put the new house in shape. There was plenty to do in the new home which has been leased at 3236 South Michigan Avenue. Redecorating was necessary from top to bottom. When this part of the work was well on its way to completion, the moving began. For almost an entire day everyone was occupied with the handling of beds, chairs, tables, and desks. The job was extremely successful, not as much as a glass or cup having been broken or damaged.

Finally, with the purchase of some new furniture, the house was completed. The boys are already well accustomed to their new home and everyone feels that it was a very wise change.

At present plans are being formulated for the annual Parents Day and the Alumni Smoker. Parents Day will be held on Sunday, November 10th and the Alumni Smoker some time in December before the Christmas holidays.

(Continued on page 30)

ALUMNI NEWS

Welfare Medal Named After Armour Grad

Creation of a medal, for award to the individual who performed the most distinguished service for the engineer last year has been announced by the American Association of Engineers.

This medal is named after Henry W. Clausen '04, a graduate of the Civil Engineering Dept., and it is known as the Clausen Medal. Mr. Clausen has at various times been a director, committee chairman and National Treasurer for the Association and it is in recognition of his services that the medal has been given his name.

The medal is a result of a three year effort by H. A. Wagner, a director for the society, to signally honor Mr. Clausen.

The spirit of youth is depicted in the design of the medal, which is the result of the genius of Elwyn Giles, youthful Kansas City designer. On the reverse side reads: "The Clausen Medal, awarded in recognition of a signal public service designed to mark the entrance of the American Association of Engineers into the field of welfare."

Alexander H. Zimmerman, Ch. E. '26, is with the Ventilating Division of the Chicago Health Department, making an investigation of smoke, fumes and nuisances. At present he is writing a series of articles for the "Aerologist" entitled "With the Advance Guard of Science."

Peter J. Marschall, E. E. '25, a member of the editorial staff of the same magazine, is writing a group of papers under the general head "Aerology for Amateurs."

Leo Lester Reihmer, M. E. '22, formerly with the American Appraisal Company, is now with the Arthur Anderson Company in Milwaukee. His very new son, Richard Allen, has filed application for matriculation in the Institute with the class of '46.

Laurence F. Pfeiler, E. E. '27, has entered the employe of Universal Wireless Communications Company, a promising new company organized to established an inter-city system of radio telegraph stations.

Fred H. Juergensen, '29, president of the senior class last year, was married Oct. 19. Fred is now with the Long Lines Department of the American Telephone and Telegraph Co.

Another recent graduate of the electrical department and employee of the telephone company is about to enter the sacred bonds of matrimony. Frank J. Pischke, '28, is the man, the date is set for November 23, and Miss Edith Godar is the lucky girl.

Frank G. Cooban '15 M. E. is now General Manager of the Gutta Percha Rubber and Mfg. Co.

Douglas R. Stiehl '26, M. E., is in charge of construction in the Engineering Division of Proctor & Gamble at Hamilton, Ontario.

F. E. Moskovics, former president of the Stutz Motor Car Co. and an Armour graduate, was elected president of the Improved Products Corp., an intermediate financing organization, last June.

Mr. Moskovics retired as president of the Stutz Motor Car Co. last January, ending a long and prominent association with the automobile industry. Previous to his Stutz connection he was vice-president in charge of sales and promotions of the Nordyke and Marmon Co., with which he became associated in 1914.

For a number of years Mr. Moskovics has been prominent in the activities of the Society of Automotive Engineers, serving as chairman of its constitution committee. He is also a member of the National Technical Committee of the American Automobile Association.

THINK RIGHT

Think smiles, and smiles shall be;
Think doubt, and hope will flee.
Think love, and love will grow;
Think hate, and hate you'll know.
Think good, and good is here;
Think vice—its jaws appear!
Think joy, and joy ne'er ends;
Think gloom, and dusk descends.
Think faith, and faith's at hand;
Think ill—it stalks the land.
Think peace, sublime and sweet,
And you that peace will meet.
Think fear, with brooding mind,
And failure's close behind.
Think this: "I'm Going to Win!"
Think not of what has been.
Think "Victory"; Think "I can!"
Then you're a Winning Man!

—*Freeburn Messenger.*

The following information concerning Charles L. Moss, E. E. '02, who is assistant manager of the Circuit Breaker Engineering Department of the Westinghouse Electric and Manufacturing Company, has been received. Mr. Moss has been with Westinghouse since 1904 and is credited with the development of several important inventions, the best known of which is the "automatic substation." In his senior year he was literary editor of the "Fulcrum," as the "Engineer" was then known.

J. J. Kanter, an Armour alumnus, received the Charles B. Dudley medal established by the American Society for Testing Materials, in recognition of meritorious papers on research in engineering materials. The award was made at the thirty-second annual meeting of the Society during the week of June 24, at the Chalfonte-Haddon Hall, Atlantic City, New Jersey.

Frank Walker '28 gained admittance to the ranks of matrimony on July 6 last. His bride is the former Miss Mary Milroy. The nuptials took place at Brookfield, Ill.

Commerce Leaders O. K. Armour's Plans

The Armour Institute of Technology's program of expansion and continuance as an independent school was endorsed by the Chicago Association of Commerce. The endorsement followed the decision of the Institute to abandon plans for merging with Northwestern University.

In the resolution of endorsement the Association cites the necessity for an outstanding technical school of the type of the Armour Institute, and expresses the hope that the support necessary to its continuance will be given by the citizens of the city.

R. S. Dean, former instructor of metallurgy at Armour, was appointed chief engineer of metallurgical division of the Bureau of Mines of the Department of Commerce last September. He took office November 1.

Mr. Dean for the last ten years has been associated with the Western Electric Co. at the Hawthorne plant in Chicago where he was in charge of metallurgical development.

Mr. Dean was born at Rolla, Mo., on Aug. 23, 1897, and was graduated from the University of Missouri in 1915. He pursued graduate study in physical chemistry at that school and at Harvard University and the University of Chicago. He taught metallurgy at the University of Pittsburgh and the Armour Institute of Technology.

Papers published by him and his associates cover investigations in flotation, chemistry of ore deposits, electrolytic refining, theory of metallic hardening, copper wire studies and alloy studies of various kinds.

In his association with the Bureau of Mines, Mr. Dean will have general supervision of the extensive program of metallurgical research conducted by the Bureau at its various experimental stations located in the principal mining districts of the country.

L. "Pack" Brown, E. E., '29, former Business Manager of the *Armour Engineer,* is now working for the V. D. Simons Engineering Company.

W. C. Healy, '29, is now employed by Foltz & Co. as a Construction Engineer.

H. Nissen, '29, is now employed by the Berliner-Joyce Aircraft Corporation under W. P. McKinnie, '29, in the designing department.

George Blair, '23, has been appointed to the fall class of flying cadets at the Army Air Corps field at Riverside, California.

Peter Alber, President Raymond's son-in-law, takes pride in the fact that President Raymond can now be known as a grandfather. Mr. Alber, in other words, is the proud father of a little girl.

William B. Blaufuss, '24, is to be a flight instructor at the Army Air Corps field, Riverside, California.

Fred B. Anderson, '21, is now the head of the Electric Service Supply Company.

AT FRATERNITY ROW

"I usually go to bed between ten and eleven."

"Not me; that's too many in a bed."

OH! MY OPERATION

"They had to give my Aunt Tillie ether twice for one operation. The first was for the operation and the second was to stop her from talking about it."

A woman can't make a fool out of a man unless she has cooperation.

The man at the wheel (noticing inebriate gentleman): "That reminds me. I must get the car oiled tomorrow."

"Rastus, did you ever have your tonsils out?"

"Only when ah laffs, suh."

When a fat person laughs there seems to be so much of him having a good time.

She wouldn't kiss me in the canoe so I paddled her back.

A negro cook answered the telephone the other morning, and a cheerful voice inquired: "What number is this?"

The cook in no mood for trifling questions, said with some asperity: "You-all ought to know, you called it."

I met her in the garden;
The night was still as death;
I knew she knew her onions;
'Cause she had 'em on her breath.

As a rule men don't marry a girl on twenty-five dollars a week, as they used to. It seems that the girl must be earning at least twice that much before they will even look at her.

Have you heard about the man who gave his wife a pair of rubber heels when she begged him for a new spring outfit.

Old lady: "I suppose when you grow up you want to do something for humanity."

Angel tot: "Yes, ma'm, I want to be a bad example."

If one of our parachutes ever fails to open for you, return it and your money will be cheerfully refunded.—An ad in Edinburgh paper.

Voice over the phone: "Is this the lady who washes?"?

Society Snob: "Indeed I should say not!"

Same voice: "Why you dirty thing!"

"A fellow wrote a letter to me saying he would kill me if I didn't stop flirting with his wife."

"Well you'd better stop flirting with his wife!"

"That leaves me in a terrible fix. He didn't sign his name."

NOBODY

He: "Then I put my hands over her eyes and said, 'Guess who this is.'"

She: "And who was it any way."

Hey: "Aren't you wild about bathing beauties?"

Day: "I don't know, I never bathed one."

Oh! for the life of a Service Station Man:—Miss .... was the fortunate winner of the twelve greasings offered by the .... Service Station.—Ad in Alabama paper.

MOST OF THEM DO

?: Can a girl do anything for an unattractive knee.

!: Nothing but grin and bare it.

A modern inventor crosses the ocean by rail.

He: "Along late in the evening the party waxed merry."

She: "Poor Mary."

"This is your last chance," said the professor, 'study hard between now and the examination—papers are now in the hands of the printer. Are there any questions?"

"Who's the printer," said a timid voice in the rear of the room.

"The wolves were upon us," said the lecturer. "Their howls and snarls were terrible. There was murder in their horrible, gleaming eyes and slavering jaws. We could almost feel their muzzles against our legs!"

"How lucky for you they were muzzled," said Dora.

Weary Willie says: "Yeah, college is fine. It's a great life if you don't waken."

MARY IS "NEAT"

Mary has a little skirt,
So neat, so bright, so airy;
It never shows a speck of dirt,
But it surely does show Mary.

School teacher: "John, you are not doing anything. The Devil always finds something for idle hands to do; come up here and I will give you some work."

Mrs. B. had always been obliged to economize in buying clothes. An aunt died and left her a thousand dollars. Mr. B. was a good sport and said: "Now dear, you can get yourself some decent clothes."

"I'll do nothing of the kind," said Mrs. B. "I'll get the kind the other women are wearing."

Teacher to bad boy: "John, you're not fit to be with good people, come up here and sit next to me."

Doctors say that healthy babies should be a delicate pink. The next door neighbors got one who's a robust yeller.

Yes, and another frosh went into the E. A. T. chapter house, 'cause he saw the sign out in front and thought the place was a restaurant.

Close friends are not as desirable as liberal ones.

"How much life insurance does your husband carry?"

"Hardly enough to be worth shooting."

A pane in the sash is worth two in the neck.

Doctor, (seeing a fire in building across the street): "Say, nurse, pull down that shade."

Nurse: "Why so?"

Doctor: "I'm afraid the patient will wake up and see it, and think the operation was a failure."

"So you go to Wis. Do you know Bill Brown?"

"Nope."

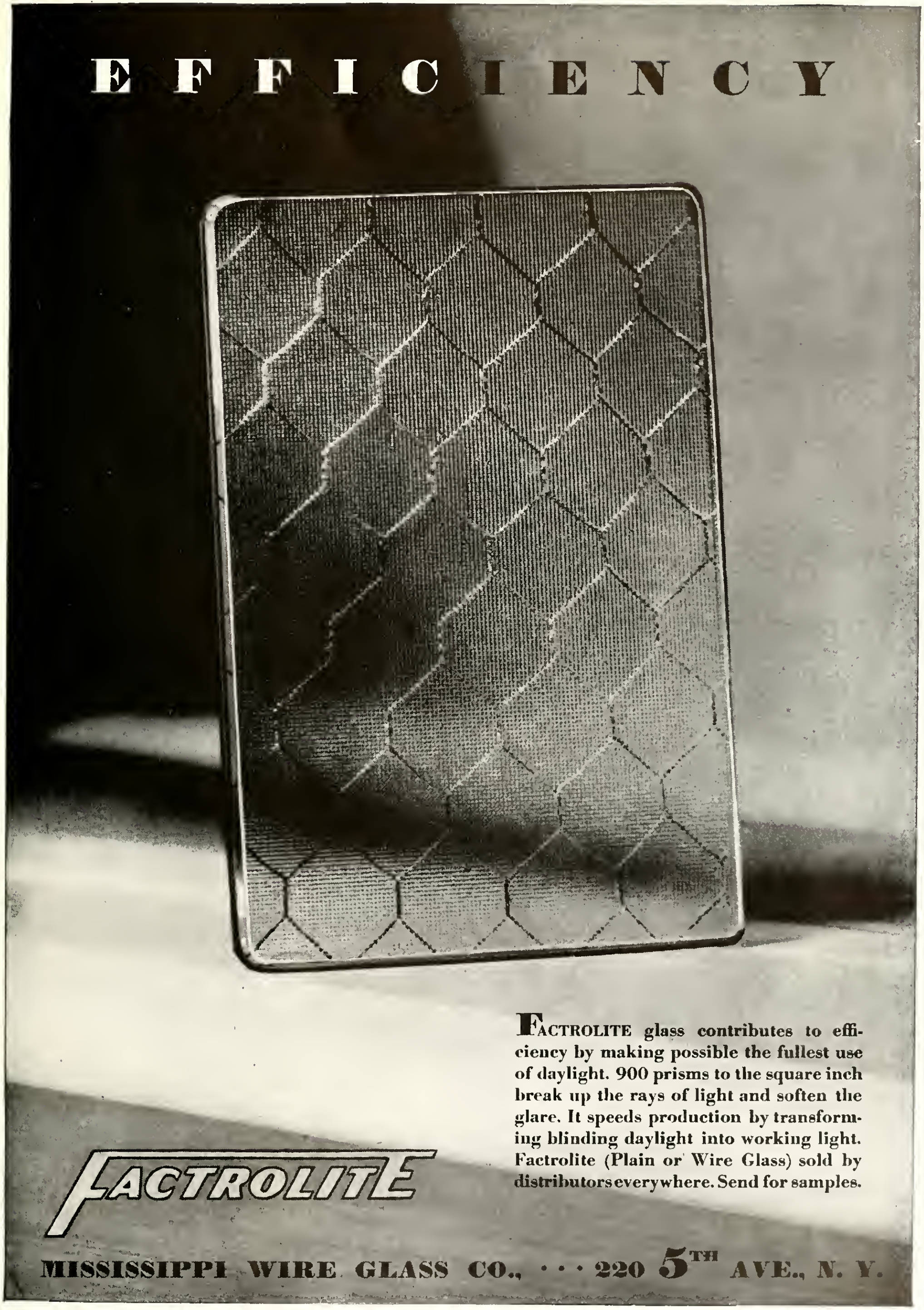
"Know Jim Slate?"

"Nope."

"Know John Fry?"

"Nope."

"Good Lord man, don't you drink?"



EFFICIENCY

FACTROLITE glass contributes to efficiency by making possible the fullest use of daylight. 900 prisms to the square inch break up the rays of light and soften the glare. It speeds production by transforming blinding daylight into working light. Factrolite (Plain or Wire Glass) sold by distributors everywhere. Send for samples.

FACTROLITE

MISSISSIPPI WIRE GLASS CO., · · · 220 5TH AVE., N. Y.

Both are lines *of* national defense

THE Mississippi was a menacing flood. The telephone was the first line of defense, for over its wires the work against the flood was directed. Maintenance crews performed the same service as did telephone men of the signal corps in the war.

In the daily life of the nation, just as surely as in emergency, the telephone meets an ever-growing stream of demands.

To do this successfully the Bell System's expansion program embraces trans-oceanic telephony through the ether and under the sea, to ships at sea and planes in the air — and above all, wire facilities that will carry the voice, the typewritten word, the picture to every corner of the land.

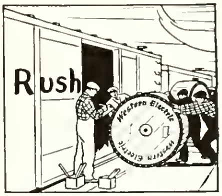
* * *

— and back of the lines stands the Western Electric *service of supply*

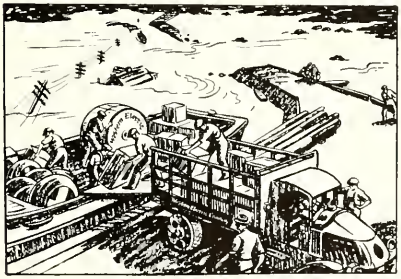
Men in the front lines of telephone service know they will always have the right tools and supplies when and where needed.

For Western Electric maintains stocks in a nationwide system of warehouses, and its prompt deliveries aid in repairing the ravages of storm, fire or flood. In the less spectacular, but equally necessary, everyday construction and maintenance of telephone lines, this service of supply is a dependable right arm.

And this is but one activity of Western Electric — manufacturers, purchasers, distributors for the Bell System.



Preparing the shipment is a matter of minutes



In the performance of these duties it either buys or makes virtually everything the telephone companies use — and then delivers to the job. Thus responsibility for the quality of materials with true economy in cost, is the important contribution which Western Electric makes as its share in efficient telephone service.

Western Electric sees it through with the material needs for promptly restoring telephone service

BELL SYSTEM

A nation-wide system of inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

CHICAGO BUILDS THE FIRST PLANETARIUM IN THE UNITED STATES

(*Continued from page 6*)

optical projectors, and five electric motors constitute the whole mechanism. The Sun, Moon, and major planets have their own separate projectors and the other lesser lights can be reproduced by superimposing two or more images. The mechanisms and optical projectors of the images of our solar bodies are arranged in tiers one above the other.

The screen for this hybrid "movie" apparatus is made of white linen stretched on an iron lattice work within the building and this arrangement provides a means of accommodating the hemispherical screen surface within an existing structure without erecting a special building for the planetarium.

Chicago, the city that, according to the ideas of those who do not know it, thrives on crime and cares little or nothing for the arts or sciences speaks with an eloquent gesture along the lake front. First the Art Institute, then the Field Museum and the Shedd Aquarium and now the Planetarium and a little later, further south, the Museum of Science and Industry, founded by Julius Rosenwald. No other American city contains either a planetarium or a technical museum. When Mr. Max Adler made the public announcement of his intention to donate the planetarium, he said, "In giving the planetarium to Chicago, I have a three-fold conception: Scientific, popular and philosophical. One is to further the progress of science. The second is to enable the people to observe the action of the heavenly bodies as heretofore only astronomers have been able to do. The third is to emphasize that all mankind, rich and poor, powerful and weak, as well as all nations, here and abroad, constitute part of one universe, and that under the great celestial firmament there is no division or cleavage, but rather interdependence and unity." The Chicago institution, under the direction of Dr. Philip Fox, will be more than a planetarium. Astronomy, the mother of the sciences, has a child called astrophysics that has been getting more and more into the public eye of late years. And so the building will house a museum of astrophysics as well as a planetarium and the mysteries of that subject that have been so much talked of will have the light turned full upon them. Astrology, which lives today in newspaper horoscopes and in the fabrications of gypsy fortune-tellers had its day and gave way to astronomy. It would be interesting to note the reactions of an astrologer of ancient times, if he could be escorted along the wind swept sands of Lake Michigan and allowed to witness a programme in the Chicago Planetarium.

SPARK PHOTOGRAPHY

(*Continued from page 11*)

total time interval elapsing between the break of the relay current and the occurrence of the photographing spark is not as important as the regularity of performance of the apparatus. The variation of the present switch seldom exceeds 0.00001 second and is usually very much less.

The gap in which the photographing spark occurs consists of two aluminum wires one mm. in diameter mounted in a bakelite cylinder in holes into which they fit tightly. This form of gap is very convenient because the gap may be removed from its holder and replaced by another with the same facility with which cartridges are changed in a revolver. This construction prevents wandering of the spark and keeps the source of light small and fixed in position.

The interrupter consists of a metal box about two inches in diameter, one side of which is closed by a metal diaphragm. An insulated contact arm supported on a taut wire normally rests against the diaphragm, closing a circuit. When the sound waves from a bullet or other source impinge upon the diaphragm, the impulse imparted to the arm causes it to swing away from the diaphragm, momentarily opening the circuit."

The only difficult part of the apparatus is that it is strictly a laboratory instrument. The whole is contained in a dust-proof case about 14 inches wide, 24 inches high, and 4½ feet long. This case has a lower section in which the photographing spark gap is mounted, having suitable diaphragms to prevent reflections from the sides of the box. The upper part of the case contains in one section the potential limiter and condenser switch, in the other half of the upper portion is the spark switch.

Extreme care has been taken as to the insulation and the placing of the wiring in Pyrex tubing. The corners of the high voltage section of the box have been carefully rounded to reduce the density of the charge and also the leakage.

It will be seen from the above description of the apparatus and the care with which it is mounted that every precaution in laboratory technique must be taken in order to obtain good results.

Spark photography is not an entirely new subject. The first spark photographs of projectiles are credited to Prof. E. Mach, of the University of Prague in 1881. Dr. L. Mach in 1893 attacked the same problem with several improvements over the earlier apparatus.

Spark photography has made the study of ballistics a practical problem instead of the theoretical subject that it was before the development of Quayle's apparatus. Mr. Quayle has succeeded in showing and proving that a projectile is acted upon by the gases for only a distance of about one foot after leaving the muzzle of the gun. Prior to this time there were very few men who agreed as to just how long the gases acted on the projectile after leaving the muzzle. Some placed this distance as great as 20 to 30 feet. From the photographs shown it will be seen that the projectile becomes subject to the influence of the atmosphere after being beyond one foot from the muzzle. In the same photograph may be noted a space directly behind the bullet where there is a slight vacuum. The sound waves are also visible in the photograph. There are two waves, one being due to the head of the bullet cutting through the particles of air and the other of the air closing about the base of the bullet.

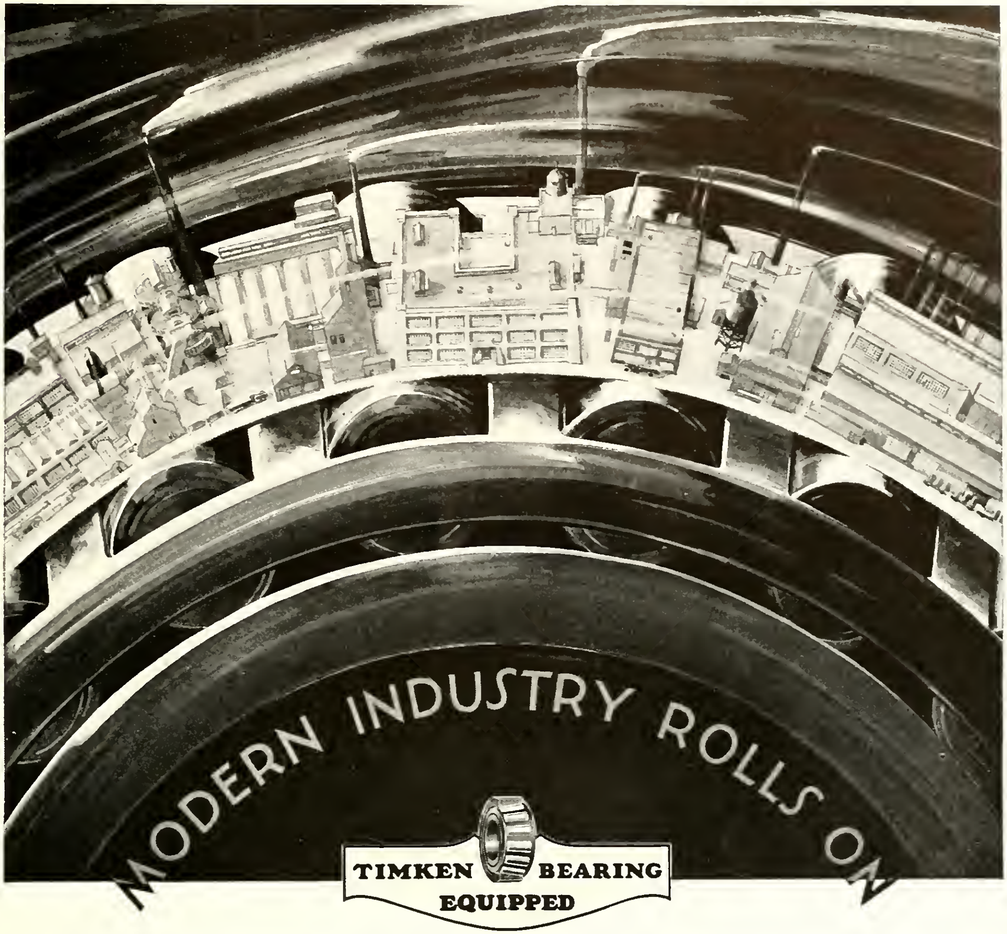
This type of photography, although at the present time being applied to the subject of ballistics, seems to have great possibilities in the study of other high speed phenomenon. It will, however, be some time before it can be applied to such phenomenon as might be found in high speed turbines or other common practical machines. When the apparatus is developed so that it can be more readily applied in every day commercial practice, there will be available much information as to various phases in the performance of machines.

WHY CIVILS STUDY CIVIL ENGINEERING

(*Continued from page 15*)

ing as to who were the actual victors. (The writer withholds his opinion on this subject).

It would be somewhat difficult to figure out whether or not this crowd was the most unruly, but it is definitely known that they weren't the most orderly group which has attended the summer camp. The last few days at camp clearly proved that. It was a common occurrence to hear some one hollering, "Got a knife?" in order to signal the one on "spot" (loafing) that a professor was coming and to get to work.



With a mighty surge Industry rolls on... and modern production rolls on Timken—*the one bearing that does all things well.*

Timken ability and versatility are destined to play a more and more important part in the future life of the nation, and student engineers will find it well worth while to make a close study of the present applications and possibilities of Timken Bearing Equipped—wherever wheels and shafts turn.

Whether the loads be all *radial*, all *thrust*, or *both in combination*, Timken Bearings —with their exclusive Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken steel—can be entrusted with the peak of the production load of the world.

Industry, Agriculture, Transportation, Mining feel the mighty momentum of modern methods... replacing the obsolete with "Timken Bearing Equipped"... stepping up the speed... defeating deadly friction ... beating down high costs... slashing maintenance... placing lubrication at an irreducible minimum... setting depreciation at defiance.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

The annual Faculty-Student dinner was consumed during a rain, and prevented the usual barnyard golf contest. There seemed to be a divergence of opinions as to who would have been victorious had the match been played.

Professor and Mrs. Leigh visited the camp one nice Sunday afternoon, and at the dinner table commented to Professor Wells on the fact that the apparent surface showed nothing demoralizing in the general attitude of the men. (A sort of calm before the storm). One of the "gang" overheard the remark and passed it along, whereupon the Civils proceeded to give a show for the benefit of their guests. Everyone, irrespective of dress was thrown into the lake. Some tried to get away from their enforced bath by changing to a swimming suit, but nevertheless were required to take the fatal plunge.

On Friday, July 19, the entire camp packed "duds" and tents, and prepared to return to the Windy City, full of vim, vigor, and vitality plus a good coat of tan and a knowledge of surveying.

In the passing, some of the fellows, over the Fourth of July, went for a hike, which reminds one of the story of the mailman who went for a walk on Sundays.

LAFAYETTE, WE ARE HERE

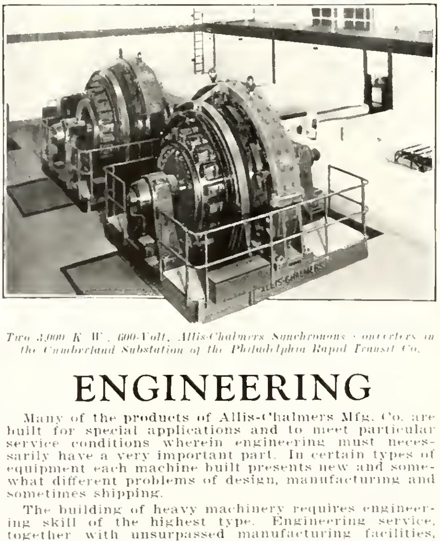
(Continued from page 14)

Morning found the students at the convention hall at the business session, where Vice-chairman Winfrey lead the discussion on principles of business practice in relation to college publications. After a short recess, a similar session was held which dealt with the editorial section of college magazines. Discussion of the topics followed and the morning session then adjourned. Luncheon was held in the same tea room as on the previous day. An inspection trip was then conducted through the principal buildings on the campus. The ever present rain did not deter many of the convention delegates from making a quick inspection of the huge armory with its motorized artillery equipment, the memorial gym, and the engineering buildings.

The afternoon session was a general round table discussion, every delegate having the right to present any problem confronting him and to expect some constructive discussion on it by which he might be aided in working towards a solution. The question of changing a quarterly magazine to a monthly proved to be of exceptional interest. All but six college magazines out of the 21 affiliated with E. C. M. A. are operating on a monthly basis. The advantages of the monthly publications over the quarterly were stressed by several editors whose publications have already taken the step and which are now successful monthly periodicals. This discussion proved to be of such general interest that the entire delegation were content to stay overtime.

After the round table discussion the Armour men inspected the school cafeteria and then proceeded to get ready for the great event which was the E. C. M. A. dance. Dates were obtainable through the courtesy of the hosts at Purdue. The Armour delegation were honored by partners from the Alpha Xi Delta Sorority, and the general opinion indicates that the dance was a huge success.

The last session of the convention was the business meeting Saturday morning. The business of the day included the presentation of awards for the past year, selecting the Colorado School of Mines as host for the E. C. M. A. convention next year, and then adjournment which brought to a close a convention both interesting and enjoyable.



Two 3,000 K. W., 600-Volt, Allis-Chalmers Synchronous Converters in the Cumberland Substation of the Philadelphia Rapid Transit Co.

ENGINEERING

Many of the products of Allis-Chalmers Mfg. Co. are built for special applications and to meet particular service conditions wherein engineering must necessarily have a very important part. In certain types of equipment each machine built presents new and somewhat different problems of design, manufacturing and sometimes shipping.

The building of heavy machinery requires engineering skill of the highest type. Engineering service, together with unsurpassed manufacturing facilities, have enabled Allis-Chalmers to solve many unusual problems in the engineering field, particularly in heavy duty power, electrical and industrial machinery.

ALLIS-CHALMERS MANUFACTURING CO.
MILWAUKEE, WIS. U.S.A.

The standard of Perfection in Art and Pencils

VENUS PENCILS

Perfection in a pencil means adaptability to the purpose for which it is made. VENUS, pre-eminently an engineer's pencil, fulfills the most exacting requirements of the most exacting of professions.

VENUS leads, the smoothest and strongest obtainable, are unvaryingly true to their shade of black which is the world's standard.

17 shades of black—3 indelible

AMERICAN PENCIL CO., Dept. Q2, Hoboken, N. J.

UNTOUCHED!

JUDGE the true worth of pipe by the number of hands that must touch it ***after*** it is installed. Pipe that needs constant pampering does not pay out. Reading 5-Point Pipe has established its record of economy on the fact that, once installed, it remains ***untouched*** by the hands of repair men during a long, long period of service.

Genuine Puddled Wrought Iron—the material of which Reading 5-Point Pipe is made—inherently possesses all of the major qualities that make pipe endure. It defies corrosion and vibration—the chief enemies of pipe vitality. It is famous for its good threading, insuring permanently tight, leakproof joints. And double welded Reading Pipe costs no more to install than ordinary cheap pipe. We'll be glad to give you the profitable facts—write us today.

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WELDS BETTER
5 POINT PIPE
READING
GENUINE PUDDLED WROUGHT IRON

GENUINE PUDDLED WROUGHT IRON
READING PIPE
DIAMETERS RANGING FROM 1/8 TO 20 INCHES

COLLEGE NOTES

(Continued from page 20)

Delta Tau Delta

Gamma Beta Chapter of Delta Tau Delta announces the pledging of the following men on October 11:

Vernon C. Alexander, C. E., '33; Frederic Clay Bartlett, Jr., Arch., '33; Marshall R. Beal, F. P. E., '32; Gerrit A. Bovenkerk, C. E., '33; Robert Henry Dorman, Arch., '33; James R. Duncan, F. P. E., '33; Raul H. Frye, E. E., '32; George G. Gebhardt, Arch., '33; Francis M. Gibian, E. E., '33; Edwin J. Griffin, C. E., '33; John F. Ireland, Ch. E., '33; Walter H. Larson, Arch., '33; Thomas D. Luckett, Arch., '33; Harold D. Marshall, F. P. E., '33; David W. Pearson, F. P. E., '23; Harold A. Pearson, E. E., '32; Raymond A. Peterson, Arch., '32; Bruce C. Scott, F. P. E., '33; Robert R. Tufts, Arch., '32.

The big affair for the month of November was the 28th Annual Wieland Freshman Banquet, held in the Red Room of the Hotel La Salle, on Saturday, November 9, 1929. The Freshmen in the entire Fraternity are invited, annually, to this dinner and they come from all parts of the United States to attend. Last year there were one hundred and nineteen Freshmen present, coming from Atlantic to Pacific and Canada to the Gulf of Mexico.

The entire Chapter accepted an invitation extended by their University of Chicago Chapter to attend a House Dance given on Saturday, November 2, 1929.

Paul Malm and James M. McAlear, M. E., '31, have not returned to school due to serious illness.

Beta Psi

Beta Chapter is pledging this year, the following men: Leroy Anderson, F. P. E., '33; Vincent J. Galvani, Ch. E., '33; Herman J. Gaul, C. E., '33; Irving C. Johnson, M. E., '32; Ralph L. Seafuri, Arch., '33; Dean B. Snapp, F. P. E., '33; Arthur L. Steinhaus, F. P. E., '33; Otto W. Staib, F. P. E., '33; Carlton E. Voltz, M. E., '32.

On Saturday night, October 5, 1929, an informal Rushee Dance was held at the Chapter house. The attractive decorations, together with good music by the orchestra, made the evening a huge success.

An informal Halloween dance was held at the Chapter house on Friday night, October 25. The house was appropriately decorated, and the dance was held in the midst of ghosts, goblins, and varied grotesque figures.

In regard to sports, interest is now being turned to basketball, and arrangements are being made for an inter-chapter game with Alpha Chapter at Urbana sometime in December.

For the Thanksgiving holidays, Beta Psi will be well represented at the annual East-West Aurora football game on Thanksgiving Day, when about twenty actives and pledges with their lady friends will motor out to the game. After the game a fine turkey dinner followed by a barn dance at Sunnyside Gables, the home of Francis Austin, near Yorkville, will be enjoyed by the party.

An inter-chapter dance will be held at the Grand Ballroom of the St. Clair Hotel on Saturday, November 30. The members and alumni of Lake Forest, Illinois, and Armour and their friends are looking forward to an enjoyable evening.

Phi Pi Phi

Phi Pi Phi wishes to announce the pledging of the following men: G. A. Brelie, F. P. E., '33; J. E. Burns, E. E., '33; H. J. Cameron, Arch., '32; J. Clayson, C. E., '33; C. Cruver, M. E., '33; J. E. Czarnecki, E. E., '33; D. R. Gregerson, C. E., '33; G. B. Kain, E. E., '33; J. P. Meade, E. E., '33; C. Mitchel, M. E., '32; V. Novack, Arch., '33; E. A. Stabovitz, F. P. E., '33.

Our annual Rush Dance was held at the Chapter House on Saturday, Oct. 5, 1929; next came the Halloween Party on October 26. Following this on the social calendar a Thanksgiving Dance was held. This occasion will be long remembered as the best party ever planned entirely by a group of Phi Pi Phi freshmen.

Phi Pi Phi wishes to take this opportunity to extend to the members of the faculty and the student body best wishes for a Merry Christmas and a Happy New Year.

Sigma Alpha Mu

Chapter activities during the summer were chiefly limited to gatherings among the fraters with one formal meeting. After the opening of school, the new quarters were fixed up and a new radio was installed. Most prominent among the possessions of the chapter is the interfraternity indoor baseball cup.

Normal fraternal activities are now under way, with a pledge party planned for Nov. 16.

Kappa Delta Tau

Kappa Delta Tau announces the pledging of the following men: P. Rosenfeld, H. Levine, J. Tuchinsky, E. Field, M. Holland, and J. Robbe.

The chapter had a very interesing summer. Several affairs were held in conjunction with the alumni, including a moonlight boat ride to Milwaukee and a golf tournament.

An informal Halloween party and dance was held on Nov. 2. The place was elaborately decorated and a large congenial crowd attended. The chapter is planning to hold in the near future an Alumni dance, a banquet for the pledges, and a New Year's Eve party.

Kappa Delta Tau takes this opportunity of extending A Merry Christmas and A Happy New Year to the faculty and student body.

A. I. E. E.

The first meeting of the local branch of the A. I. E. E. was a joint meeting with W. S. E. on Friday, November 1st. Mr. H. H. Field, of the Northern Illinois Public Service Company, who for the last two years has served as Secretary of the Electrification of Steam Railroad Committee, gave an illustrated slide lecture on "Electrification of Railway Lines in Europe."

Mr. Dollenmaier announced the members of his committees. The meetings and paper committee consists of Baker, chairman; Zimmermann, Sanborn, Bigelow, and Patzelt; the men on the social committee are Serson, chairman, Stier, Hanke, Roffee, and Kellner. The chairman of the membership committee is Southwick and the members are Drigot, Knittel, Fetterman, and Johnson.

The officers this year are J. M. Dollenmaier, Chairman; J. G. Papantony, Vice-Chairman; C. E. Rudelius, Treasurer, and S. Janiszewski, Secretary.

ENGINEERING NEWS

(Continued from page 17)

which is located in the same station, is rated at 214,000 horsepower, while the next in size develops less than 150,000 horsepower.

With the 220,000 horsepower generated, a million homes can be lighted at the same time, or excellent illumination could be provided for a road running around the earth twice.

Though massive in construction and imposing in appearance, the Hell Gate unit is remarkable, rather for its compactness, than its size. Close to this new unit, in the same station, is a 67,000 horsepower machine which was installed several years ago as the engineering feat of the time. The new unit although it develops more than three times the power of the older unit, is less than twice its size.

The unit is of the cross-compound type: that is to say, it consists of two turbines, one being operated from a high-pressure steam source, and the other getting its steam from the exhaust of the first. Each turbine drives a generator rated at 80,000 kilowatts. The low pressure turbine is also required to drive a third generator rated at 5,000 kilowatts, which is used to supply the power used in the plant itself. The two main generators are enclosed in a single semi-circular housing into which cooled air is blown, for ventilating purposes.

Steam is supplied at 265 pounds gauge pressure and 700° Fahrenheit and is discharged into the condenser at a pressure of 1 inch mercury absolute. To condense it 155,000 gallons of cooling water are pumped through the condenser every minute.

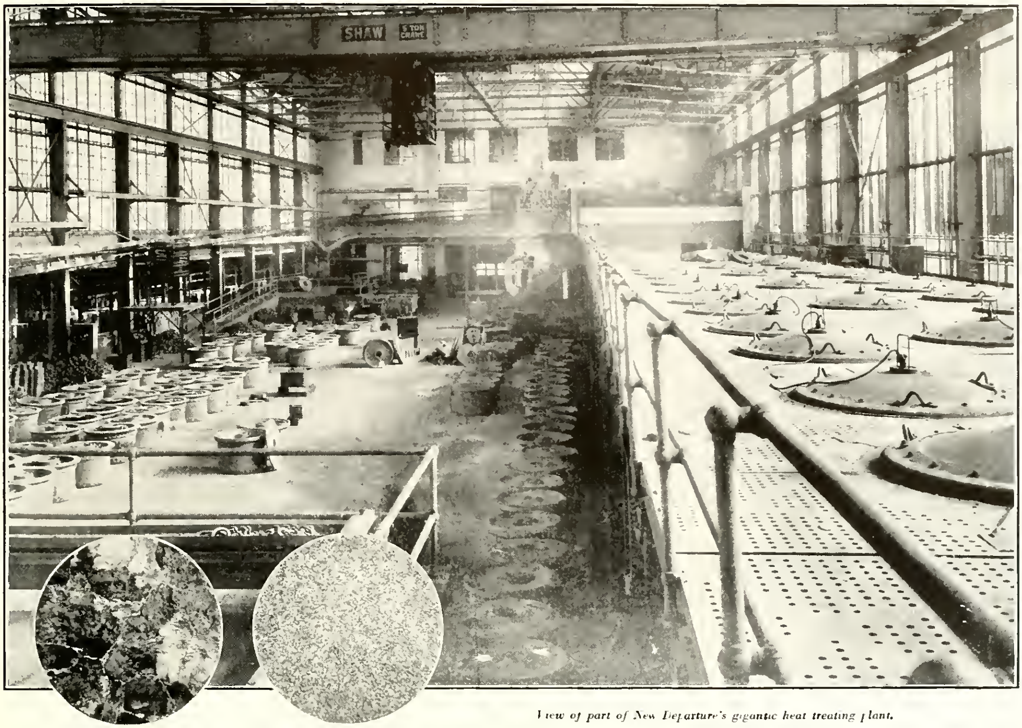
The dimensions of the unit are: length 91½ feet, width 40 feet, height above floor line 27½ feet, weight 1,300 tons, and speed 1,800 revolutions per minute.

In installing the 220,000 horsepower giant, the United Electric Light and Power Company placed itself foremost in the field of electrical progress. Its Hell Gate Station being the largest in the world, with a total capacity of over 800,000 horsepower.

New Lighting Institute Opened

A city of light has suddenly appeared in the heart of New York City. This city which is officially known as the Westinghouse Lighting Institute, occupies the entire seventh floor of the Grand Central Palace. This institution was founded for the purpose of studying and improving modern lighting.

Controlling the Unseen in Steel



View of part of New Departure's gigantic heat treating plant.

PHOTOMICROGRAPH of bearing steel after forging, etched with nitric acid and magnified 1,000 diameters.

THE same steel after normalizing and annealing. Showing fine spheroidized grain structure so important to strength.

AFTER forging, the next step in the preparation of the steel for New Departure Ball Bearings is to relieve all internal strains . . . to refine the grain and to soften the steel to a point where it may be readily machined.

The grain is refined by normalizing in the batteries of oil-fired furnaces shown above where a relatively high temperature is maintained uniform by the use of electric pyrometers.

After a precisely determined time the forgings are removed and allowed to cool in air. This operation removes the heterogeneous structure of the steel and puts it in the best possible condition for annealing.

Annealing is required to soften the steel and eliminate strains from forging. This heat treatment brings the forgings to a temperature just below the hardening or critical range of the steel and holds this temperature for a relatively long time.

Through special processes unique with this company the steel is spheroidized — or brought to a structure of minute spheres. By this method can New Departure's special analysis, high carbon chrome alloy steel be cut with relative ease without tearing.

Only by an intimate knowledge of metallurgy and the ability to control the unseen in steel are New Departure Ball Bearings produced with a uniform endurance unsurpassed elsewhere in industry.

New Departure Ball Bearings

The New Departure Manufacturing Co.,
Bristol, Connecticut
Chicago · Detroit · San Francisco

115

In the Institute, there has been erected a full sized city street 180 feet long and 20 feet wide, and also a cross street 85 feet in length. Along the sides of the streets, buildings have been erected such as a bank, gas station, home, offices, shops and the like. The street is constructed so that it can be lighted to 20 different degrees of intensity. When you stop to think that this permanent exhibition occupies 40,000 square feet, or an entire city block some idea of its size can be visualized. It is planned that this institution is to be used for all persons interested in the electrical art for the solution of these problems. It will also be a meeting place for students of technical schools and colleges.

According to A. E. Allen, Vice-President of the Westinghouse Lamp Company, this Institute is the Westinghouse Lamp Company's contribution to the electrical industry.

The Institute has taken pains to make the problem of the proper application of light as interesting to the suburbanite, or the farmer, as it will be to the metropolitan urbanite or airport floodlight electrician. Nothing has been overlooked or done in a haphazard manner in its construction.

One of the most interesting sections is the transportation room, in which is located an aviation field. Every small detail in illumination has been reproduced, even, to the illuminated windsock on the top of the hangar. The field is so arranged so that it represents an area of 250 square miles.

In another section, a model school room has been set up which will accommodate 35 people. It shows something which hardly exists today, that is the proper illumination of blackboard spaces, together with a modern general and unit system of ventilation. This same room is used to illustrate artificial daylight.

In the art gallery of the Institute, a demonstration of a newly developed lens principle can be performed, which permits the lighting equipment to be recessed on structural surfaces. With this system light goes to higher intensities without the least discomfort to the eyes of an observer.

From these few examples of what is provided for study in this Institution, it can be readily seen that every phase of lighting has been given attention.

Courage in Concrete Construction

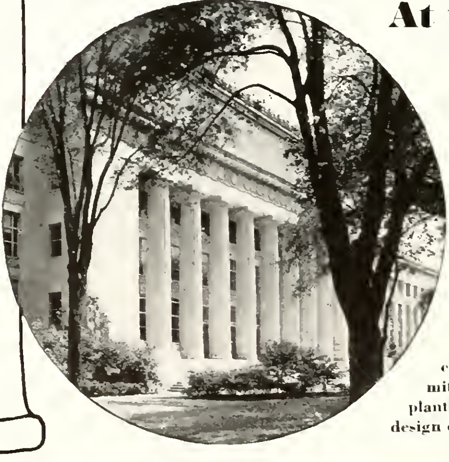
According to the American conception and experience in concrete, the Elorn bridge in France with its three arches of 612 feet span, is what we might truly characterize as a courageous feat. Few of our large concrete bridges have attained half that span. To understand this remarkable structure entirely new conceptions as to the structural use of concrete are necessary. Where we used a 650 pound unit stress for 2,000 lb. concrete, this bridge was designed on the basis of 1,000 lb. per square inch; using an 8,500 lb. quite regularly throughout the construction period. Where we use a liberal quantity of steel reinforcement to take tensile stresses, the French designers have considered it only as an aid against changes in the arch due to temperature changes. American engineers have often smiled at the European idea of having variable and diverse concrete strengths in the same structure, the feeling being that they were bending practice to suit their own theories instead of making practice fit the theory. In the building of their dams the idea in this country has been that they have merely placed their concrete in so-called variable strengths and still only receive a uniform structure. With this new bridge it is wholly different: either the concrete is as good as it is claimed to be or else the bridge is unsafe. Thus far indications show that the structure is just as sound as it is bold.

Choice of America's Colleges

TAYLOR STOKERS

Purdue
Vassar
Johns Hopkins
Catholic University
Wisconsin
Ohio State
Kansas
Princeton
Michigan
Duke
Detroit
Concordia
Tennessee
New Hampshire
Penn State
W. Virginia

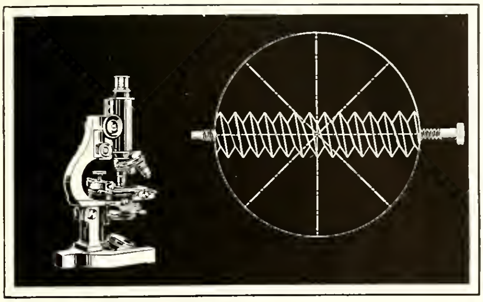
At the University of Michigan . . .



WHERE Knowledge is Power . . . in America's great Colleges, Universities and Hospitals . . . you will find the TAYLOR STOKER, chosen as the supreme combustion machine by engineers who know the best, and demand the best, for power and heat. It is significant that the University of Michigan selected TAYLOR STOKERS for its power and heating plant.

TAYLOR STOKER combustion is complete and smokeless. For this reason TAYLOR STOKERS are admirably adapted to the college community, their use permitting the construction of power and heating plants which conform architecturally with the design of the other college buildings.

AMERICAN ENGINEERING COMPANY
2441 Aramingo Avenue Philadelphia, Pa.



"How can I best inspect precision tools?"

A manufacturer said to us: "I must measure a number of templets frequently. Great accuracy is imperative. An optical method may speed up the process . . ." The B. & L. Toolmakers' Microscope—used in many other industries—was the simple solution to this problem. In every phase of industry special optical instruments are solving problems of inspection and production control better and more economically. Bausch & Lomb scientists have studied many industrial fields. Their experience may be invaluable to you. Call on them.

BAUSCH & LOMB OPTICAL CO.

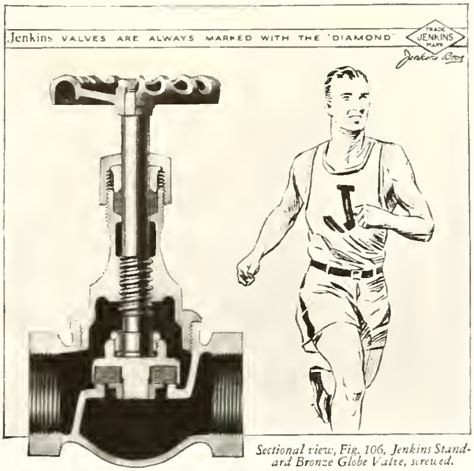
635 St. Paul St. Rochester, N. Y.

There is a *Tycos* or *Taylor* Temperature Instrument for every purpose

Taylor Instrument Companies
ROCHESTER N.Y. U.S.A.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments
INDICATING-RECORDING-CONTROLLING


Jenkins VALVES ARE ALWAYS MARKED WITH THE "DIAMOND"
TRADE JENKINS MARK
Jenkins Bros

Sectional view, Fig. 106, Jenkins Standard Bronze Globe Valve, screwed.

Where body stamina counts

In the long grind, it's the athlete with the stamina who lasts.

So, too, with a Jenkins Valve. It's the body stamina that counts, that keeps the valve in the line, unaffected by the strains of pipe weight and settling, lifting, expansion, contraction or frequent operation.

Jenkins bronze valves are cast of virgin metal; Jenkins iron body valves of a high quality, close-grained mixture. Metals are analyses-controlled by Jenkins metallurgists. Skillful design is provided to make possible an even distribution of metal throughout the valve body.

Jenkins Valves are made in bronze and iron, in standard, medium and extra heavy pattern—a valve for practically every valve need.

Send for a booklet descriptive of Jenkins Valves for any type of building in which you may be interested.

JENKINS BROS.

80 White Street . . . . New York, N. Y.
524 Atlantic Avenue . . . . Boston, Mass.
133 No. Seventh Street . . . . . . Philadelphia, Pa.
646 Washington Boulevard . . . . . . Chicago, Ill.
JENKINS BROS., Limited
Montreal, Canada London, England

Jenkins
VALVES
Since 1864

High Pressure Boilers

Two steam generating units to operate at 1400 lb. steam pressure and 750 degrees Fahrenheit are to be installed in the Fordson Power house. These units will have a maximum capacity of 700,000 lbs. of steam per hour. This will be the largest steaming capacity for any boiler units built for pressures as high as 1400 lbs. per square inch.

The equipment for each boiler will include a boiler, a water-cooled furnace, two air preheaters, an economizer and a pulverized fuel firing system.

The total heat absorbing surface of each unit will be 108,296 square feet. Of this surface less than thirty per cent is boiler heating surface proper. The two preheaters have a heating surface of 32,400 sq. ft. The economizer surface will be 5,786 sq. ft.

The boiler will be fired by pulverized fuel which will be blown into the furnace through horizontal burners located in the furnace corners. These burners are to be so placed to give a swirling effect so as to properly mix the constituents for combustion.

Leviathans of the Air to be Flying Hangars

The spectacular voyage of the great "Graf Zeppelin" around the world has helped to focus the public eye on the unique Goodyear project, at present under way, of constructing two Zeppelin airships which will dwarf in their proportions and cruising radius anything the world has yet witnessed.

The German airship with its gas bag of 3,700,000 cubic feet capacity half as large again as the "Los Angeles," will look insignificant alongside of the twin Leviathans of the Navy, the ZRS-4 and ZRS-5, in each of which the gas bag will measure 6,500,000 cubic feet.

Each one of these giant ships will carry within their hulls five airplanes, housed in a hangar of suitable dimensions. These planes will be able to take off the airship by lowering a trapeze through large sliding doors at the bottom and will be caught in mid-air and hoisted back by means of the same contrivance. Their cost will be $7,825,000 and the Goodyear Zeppelin Corporation will build them, at Akron, Ohio, U. S. A., the first one to be completed in thirty months. It will be 785 feet long of a maximum diameter of 133 feet, will have a gross lifting capacity of 403,000 pounds, and carrying a useful load of 182,000 pounds. Its eight engines will develop 4,480 horse power and it will have a cruising range, without refueling of 9,180 miles at 50 miles per hour—2½ times as great as that of the "Los Angeles." The gondolas containing the engines and crew will be housed within the hull, including comfortable sleeping and mess rooms. The control cabin will be the only projection in the otherwise perfect streamlining of the body.

The actual assembly of the first of the big ships cannot proceed until the building housing it will have been partly roofed over. This building is at present under construction.

The structure will be the largest edifice built by man. The floor area covered by a single span roof, unsupported by pillar or post, will be nearly nine acres in area, 1200 feet long, 325 feet wide and 205 feet high. Fourteen football games could be played under its roof at the same time.

The Broken Wheel

By Edgar A. Guest

We found the car beneath a tree
"The steering knuckle broke," said he;
"The driver's dead; they say his wife
Will be an invalid for life.
I wonder how the man must feel
Who made that faulty steering wheel!"

It seemed a curious thought, and I
Sat thinking as the cars went by
About the man who made the wheel
And shaped that knuckle out of steel;
I tried to visualize the scene—
The man, the steel and the machine.

Perhaps the workman never saw
An indication of the flaw,
Or, seeing it, he fancied it
Would not affect his work a bit,
And said: "It's good enough to go,
I'll pass it on. They'll never know."

"It's not exactly to my best
But it may pass the final test;
And should it break, no man can know
It was my hand that made it so.
The thing is faulty, but perhaps
We'll never hear it when it snaps."

Of course the workman couldn't see
The mangled car beneath the tree,
The dead man, and the tortured wife
Doomed to a cripple's chair for life—
His chief concern was getting by
The stern inspector's eager eye.

Perhaps he whistles on his way
Into the factory today
And doesn't know the ruin wrought
By just one minute's careless thought.
Yet human life is held at stake
By nearly all that toilers make.

The operation shown in the photo of placing the central arch in position was the most delicate and difficult part of the whole construction. The arch is in the exact center of the building and six more will be built on either side of it. The main construction problem was meeting the cross-hangar wind pressures and preventing the formation of sharp gusts and eddies springing up around such an immense bulk, which might endanger the launching and housing of the airship. In order to avoid steep walls and sharp corners, the entire structure will be nearly oval in form, only the first 27 feet of the walls being vertical; from this point on the great height of it will be virtually one vast self-supporting arch. The roof and walls of sheet steel will be strengthened by new deep V-shaped corrugations.

The entire building will be placed on rollers, to allow the huge fabric of steel to "stretch" and contract with variations of temperature which may amount to a foot between summer and winter; else constant strains and warping of the fabric would soon disrupt its unity. The steel arches supporting the sheathing will be hinged on these rollers and these in turn will rest upon concrete foot-plates, built upon concrete piles driven down to bedrock, thirty feet below. The hinges will weigh 3½ tons apiece.

To conform with the streamline design of the hangar, four doors at the ends will be likewise oval shaped, each resembling a quarter section of the skin of a halved orange. Each one of these doors, moving on semi-circle tracks, will weigh 800 tons, the weight of a good-sized passenger train.

There are no hinges other than huge steel pins at the apex. These "pins" are massive shafts, each 4 feet long and 17 inches thick. After the immense doors have been set in motion, only the exertion of an immense counterforce can stop them. This is accomplished by electro-hydraulic brakes. Five minutes are required to open or close the doors. When fully opened, they rest against the sides of the building, producing no greater air disturbance than when closed.—*Pure Iron Era.*

The Iron Church of Manila

The city of Manila, capital of the Philippines, boasts of the only church in the world built throughout of iron.

Erected in 1891 by the barefooted Augustinian Friars known as the Recollect Fathers, on the site of a chapel founded by that order in 1622 and destroyed by earthquake, it presents a fine example of stern Gothic architecture. With its slender spires and sweeping vertical lines, it is the tallest and most impressive edifice in that city.

The whole building above the foundations was manufactured in sections by the Belgian Society of Public Works (Societe Anonyme d'Enterprises de Travaux Publiques) of Brussels, designed by Mr. J. Bazain. The total floor space covered by the church is 7,690 square feet and the twin spires

(*Continued on page* 38)

GLUE

.... Holds The World Together

This is the first of a series of advertisements that will appear in the ARMOUR ENGINEER dealing with the by-product activities of Armour and Company—activities that have sprung naturally from the packing industry, yet have developed into large, specialized businesses of fundamental importance. The first of the series deals with Glue.

THE manufacture of glue is an industry as old as the ages. The pages of history disclose, three thousand years ago, the cabinet makers of ancient Egypt laboriously putting together the various parts of their handicraft with a crude form of glue, made under most primitive methods.

3000 years ago . . . . Meanwhile the processes of evolution have transformed ancient Egypt into the modern world; research and science has made commonplace to us today that which would have been miraculous in ancient or medieval times; production and marketing methods have advanced to a basis of scientific control:—but glue and glue-making were not a part of this transition.

Thru the ages, glue remained glue, with little regard for the raw material from which it came and the quality of the finished product.

Then a consciousness was awakened to the difference between glues made from the hides of animals and glues made from their bones. Then, gradually, users began to make certain crude tests of various elementary qualities, but these tests relied primarily on the physical senses, and were usually unreliable.

Only a few years ago, comparatively, was glue finally lifted out of crude speculation as to quality and elevated to an exact scientific method of grade measurement. The laboratories of Armour and Company, in cooperation with one other laboratory, were the pioneers who developed the new methods that have since been recognized the world over . . . . and indeed have recently been accepted as standard by the United States Government.

Armour and Company has also pioneered in adapting the form of glue more specifically to the user's needs. For generations, glue was delivered to the user in a flake form. Then came ground glue—only comparatively recently, however. This speeded up his production and was, in many cases, much more practical for his own purpose. Within the last decade, a new process has been invented. It gives the manufacturer glue in the form of a small pearl, combining all of the advantages of both flake and ground glue in a product that permits a further speeding up of production and at the same time guarantees a cleaner and purer product.

Armour and Company were the first to introduce Pearl Glue on a wide scale in this Country and at the present time is the only manufacturer from whom an appreciable supply of this glue is available.

Likewise in marketing practice Armour and Company have left the beaten paths to lead with new ideas.

A staff of trained chemists is maintained for the purpose of contributing the latest thought on good and economical glue practice. Scores of special problems weekly find their way from the manufacturing field to the Armour Laboratories, and painstaking reports are returned giving constructive help.

Out in the field, in addition, Armour and Company maintains chemical engineers who go wherever they are needed, on request, to analyze plant equipment, gluing procedure, and adaptation of grade of glue. Their sole purpose is to give assistance in improvement of finished quality or reduction of manufacturing cost.

So to the industrial engineer and to the student who seeks to bring the wisdom and logic of science to the performance of the task in hand, we say:

If it involves the use of glue, let our technical service give you the benefit of a prolonged and varied experience. Take advantage of our numerous resources which are always available to you

ARMOUR GLUE WORKS

Owned And Operated By

ARMOUR AND COMPANY

1355 W. 31st St., Chicago, Ill.

Armour Institute of Technology
Chicago

The College of Engineering Offers Courses in
ELECTRICAL ENGINEERING
MECHANICAL ENGINEERING
CIVIL ENGINEERING
FIRE PROTECTION ENGINEERING
CHEMICAL ENGINEERING
ARCHITECTURE

These courses are each four years in length and lead to the degree of Bachelor of Science

COMPLETELY EQUIPPED SHOPS AND LABORATORIES

The Institute Bulletins
Will be Sent on Application

A WONDERFUL DAY

(*Continued from page 13*)

out? He "hung me" up twice before on logs and got away. Now he moves. He is going right out for deep water. What a relief. The slack is quickly reeled in. The canoe is favorably turned. Only a scant 30 feet now separates us as he comes to rest. Did he drop it? Will he swallow the bait? Numbers of seconds go by awaiting the turning of the bait. There is swish of the line circling through the water. The reel hums. The line now rises. He has felt the hook and is coming to the surface to "throw the bait." I strike with a terrific smash to sink the hook through bone, grissle or flesh. Out of the water up in the air the fish leaps three feet. I yell, "30 pounds!" The guide cries, "40" and the battle is on. Now giving line, now retrieving line, sometimes clamping down on the reel and literally towing him, the guide always cautiously moving away from snags and weeds to deep water. Here with some frantic rushes and several great leaps out of the water he soon tired. He was brought alongside of the canoe. What a beauty he was. His sides treaked and white were resplendent in the setting sun. His species is well named—the tiger muskie. He is brought into the canoe, weighed and measured. He tipped the scales at 32 pounds and was 51 inches long from tip to tip. With war cries we turned for home. Never did nature look so lovely, never was the shore line more beautiful, never did the return trails and lakes seem so short.

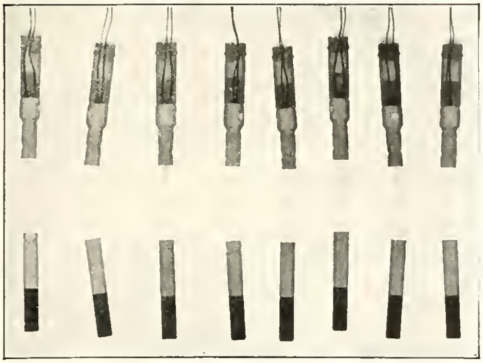
We arrived at camp late that evening and rang the bell—the signal when a big muskie is placed on the grass at camp. After telling the story a dozen times, the guide and I went to the kitchen and had a light repast. After finishing with the meal, my eyes gazed in the distance and my mind was back on Round Lake. My wife noticing my quietness, exclaimed, "John, what kind of time did you have?" and I replied, "Just a wonderful day!"

A name which for years has identified the finest tapes and rules on the market, regardless of price.

LUFKIN
LUFKIN
LUFKIN
LUFKIN
LUFKIN

Let us send you Catalog

THE LUFKIN RULE CO.
SAGINAW, MICH.
106 LAFAYETTE ST., NEW YORK



This illustrates the use of X-ray photography in testing for uniformity in Hercules delayelectric blasting caps. The X-ray reveals, from top to bottom of each delay electric blasting cap, the lead wires, firing head, delay fuse (in which only the powder train shows), and the blasting cap.

WHY
HERCULES DETONATORS
ARE RELIABLE

EXHAUSTIVE attention was given to the basic design of Hercules Detonators. They are manufactured with painstaking care from materials selected and tested with equal vigilance. After all that is humanly possible has been done to control the manufacturing processes, the product is subjected to a series of elaborate and costly tests.

In making these tests, many branches of science are utilized. The X-ray looks through the copper shells to search out any flaw which previous to this scientific operation, could only be found by destroying the detonators. Microphotography is called upon to tell a significant story to the explosives chemist. All standard tests of recognized value as well as special tests devised in the Hercules laboratories are used to insure the reliability of Hercules detonators.

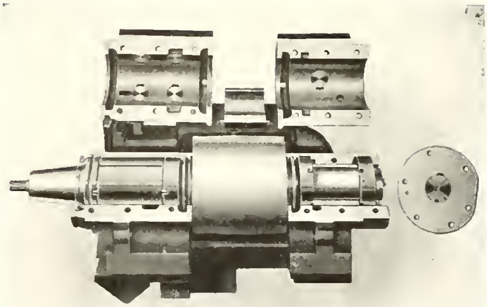
HERCULES POWDER COMPANY
(INCORPORATED)
Wilmington Delaware

HERCULES POWDER COMPANY, 941 King Street, Wilmington, Del.
Gentlemen: Please send me your book "Hercules Detonators."

Name..........

Address..........

2646

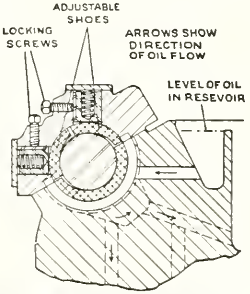


UNIQUE SPINDLE CONSTRUCTION
—an important feature of the "30 series" Brown & Sharpe Plain Grinding Machines

ADJUSTMENT of the wheel spindle boxes in these machines is made while the machine is running and is extremely simple—the success of the adjustment in no way depending upon the skill of the operator.

A turn of the locking screws releases the plungers which are actuated by springs of the correct tension. These plungers automatically apply sufficient pressure to bring the adjustable shoes to their proper positions. Tightening the locking screws positively clamps the plungers, holding the shoes in their new positions. The springs can apply only the correct pressure upon the shoe, preventing a break in the oil film by too closely adjusted boxes and consequent injury to the spindle.

This feature is only one of the many reasons for the success of these machines wherever they are installed. An interesting booklet describing them will be sent at your request.



BROWN & SHARPE
BROWN & SHARPE MFG. CO. BS PROVIDENCE, R. I., U. S. A.

ARMOUR TECH ATHLETIC ASSOCIATION

Treasurer's Report, College Year 1928-29

Receipts			
Cash Balance, September, 1928			$ 3,854.30
148 Senior student fees, at $7.50, 1st Semester		$ 1,110.00	
676 Student fees, at $8.50, 1st Semester		5,746.00	
		$ 6,856.00	
Less class dues		676.00	6,180.00
140 Senior student fees, at $7.50, 2nd Semester		$ 1,050.00	
651 Student fees, at $8.50, 2nd Semester		5,533.50	
		$ 6,583.50	
Less class dues		651.00	5,932.50
Interest on bank balance			274.62
Expenses			$16,241.42
"A" Blankets		$ 95.00	
Armour Engineer	$2,206.15		
Advertisements and subscriptions	1,415.19	790.96	
Baseball		22.21	
Basketball		450.25	
Boxing and Wrestling		118.87	
Cycle	3,845.85		
Adv., sale of books and donations	1,715.07	2,130.78	
Directors and Coaches		4,618.75	
General Expense		78.55	
Golf		284.48	
Medical Expense		122.40	
Musical Clubs		542.74	
Rifle Club		29.75	
Swimming		104.71	
Tennis		715.86	
Track		407.10	
		$10,512.41	
Cash Balance	$6,987.76		
Less Class Balances	1,258.75	5,729.01	$16,241.42

mount to a height of 170 feet. The truss framework of the walls is faced with iron plates, both inside and out, spaced 9.6 feet apart and filled with cement, clay and sand as insulation against outside heat. The wallplates are held out from the cross beams by wedges which prevent warping and vibration. The iron plates are described as No. 3 (B.B.B.) Belgian iron of which 795 tons were used for exterior sheathing and 300 tons for interior sheathing, besides galvanized iron for roofing of the spires and dome, approximately 19 tons.

The reason the Recollect Friars decided upon an iron church was that they had previously lost three churches built of stone and brick, through earthquakes; they wanted a building that would withstand the climate, earthquakes, and fire, and thus conceived the idea of iron walls.

Twelve stained glass windows illumine the interior and there are four beautiful rose windows. The interior is very impressive with its tall fluted columns—likewise made of iron—and gothic arches groined and fanribbed at the top, a fine cupola rising in the center, decorated with frescoes of Carmelite Saints.—*Pure Iron Era.*

Steel Sheets
THAT GIVE MAXIMUM RUST-RESISTANCE!

KEYSTONE COPPER STEEL
AMERICAN SHEET AND TIN PLATE COMPANY PITTSBURGH

Highest quality steel sheets for the engineering, railway, industrial and general construction fields. This Company is the largest and oldest manufacturer of Black and Galvanized Sheets, Keystone Rust-resisting Copper Steel Sheets, Tin and Terne Plates adapted to all known uses. Sold by leading metal merchants.

The products of this Company represent highest standards of quality and service. *Made right—sold right.*
CONTRIBUTOR TO
SHEET STEEL
TRADE EXTENSION COMMITTEE

AMERICAN
STEEL SHEETS *for* Every Purpose

DISTRICT SALES OFFICES: Chicago, Denver, Detroit, Cincinnati, New Orleans, New York, Philadelphia, Pittsburgh, and St. Louis. Write nearest Sales Office for information and booklets.

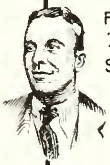
Manufactured by
American Sheet and Tin Plate Company
General Offices: Frick Building, PITTSBURGH, PA.
SUBSIDIARY OF
UNITED STATES STEEL CORPORATION
Quality Products *Dependable Service*
PRINCIPAL SUBSIDIARY MANUFACTURING COMPANIES:
American Bridge Company
American Sheet and Tin Plate Company
American Steel and Wire Company
Carnegie Steel Company
Cyclone Fence Company
Federal Shipbuilding and Dry Dock Company
Illinois Steel Company
Minnesota Steel Company
National Tube Company
The Lorain Steel Company
Tennessee Coal, Iron & R. R. Company
Universal Portland Cement Company
Pacific Coast Distributors—United States Steel Products Company, San Francisco, Los Angeles, Portland, Seattle, Honolulu. *Export Distributors*—United States Steel Products Company, New York City

WHERE QUALITY IS PARAMOUNT

Oxy-acetylene welding is used for joining fuselage members in the construction of over 85% of the airplanes built in this country. In this service hundreds of thousands of oxwelded joints have proved their dependability and strength under all conditions—in the Tropics—on Polar explorations—on endurance and trans-oceanic flights and for routine commercial flying.

No field of industry makes more exacting demands of quality and performance than the manufacture of aircraft. The modern plane is tested and inspected thoroughly in every stage of its construction. Quality of design, materials and workmanship is paramount. Acceptance of oxy-acetylene welding as standard practice in this new and progressive industry is of outstanding significance.

C. G. JAX
District Sales Manager,
University of Wisconsin 1924
Crew Committee Member
Chi Phi Fraternity



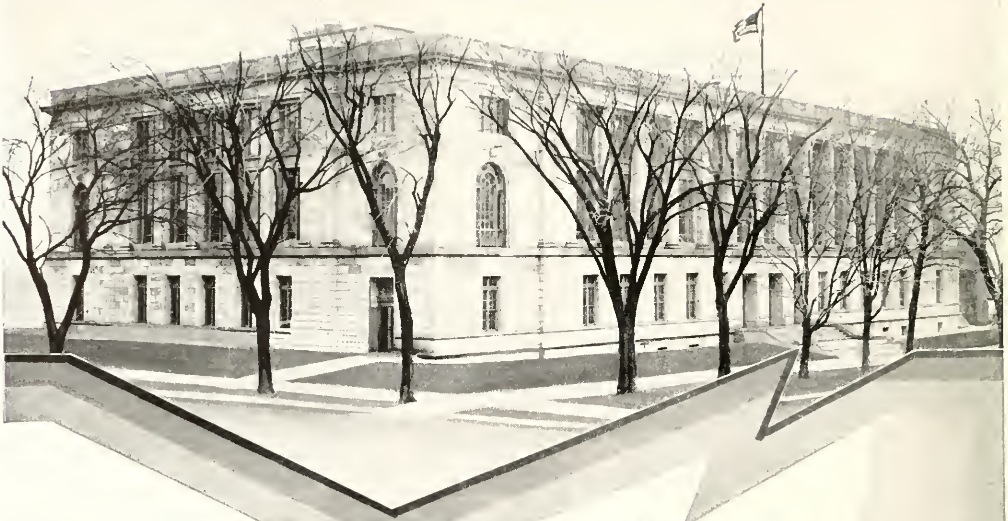
F. F. STODDARD
Technical Publicity Dept.
Syracuse University 1926
Football 4 years
Lacrosse 4 years
Individual Trophy 1926
All American 1926
Basketball 2 years
Phi Delta Theta Fraternity

From time to time the oxy-acetylene industry is in the market for technically trained men. It offers splendid opportunities for advancement.

One of a series of advertisements featuring College men serving this industry.

The Linde Air Products Company — The Prest-O-Lite Company, Inc. — Oxweld Acetylene Company — Union Carbide Sales Company — Manufacturers of supplies and equipment for oxy-acetylene welding and cutting— *Units of*

UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street UCC New York, N. Y.



Koehring-Mixed Foundation
for Federal Building

Probably one of the most interesting and attractive of the federal buildings erected during the last year is the United States Post Office and Court House at Madison, Wisconsin. In addition it is one of the first in the building program resumed since the World War.

Situated in the shadow of the state capitol and only a few hundred feet from Lake Monona, one of the four lakes which surround Madison, the three-story building of Bedford stone has an ideal setting.

Employing the latest methods in the interior transfer of mails the Post Office department arranged the rooms, conveying machinery and platforms to bring about greater ease and speed in the handling of all classes of mail.

In the main lobby, marble slabs cover the walls from the floor to a height of eight feet. Quarter-sawed oak is the interior finish throughout the building.

Despite other unique features found in the Madison Post Office, its foundation of dominant strength concrete is similar to that of other well-known building projects throughout the world — concrete mixed by a Koehring.

The ingredients of concrete are the same in all cases but the Koehring re-mixing action — a fundamental principle of Koehring concrete mixers and pavers — coats every particle of sand and gravel with cement to produce dominant strength concrete.

"Concrete—Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, will be gladly sent on request to engineering students, faculty members and others interested.

KOEHRING HEAVY DUTY

NEC

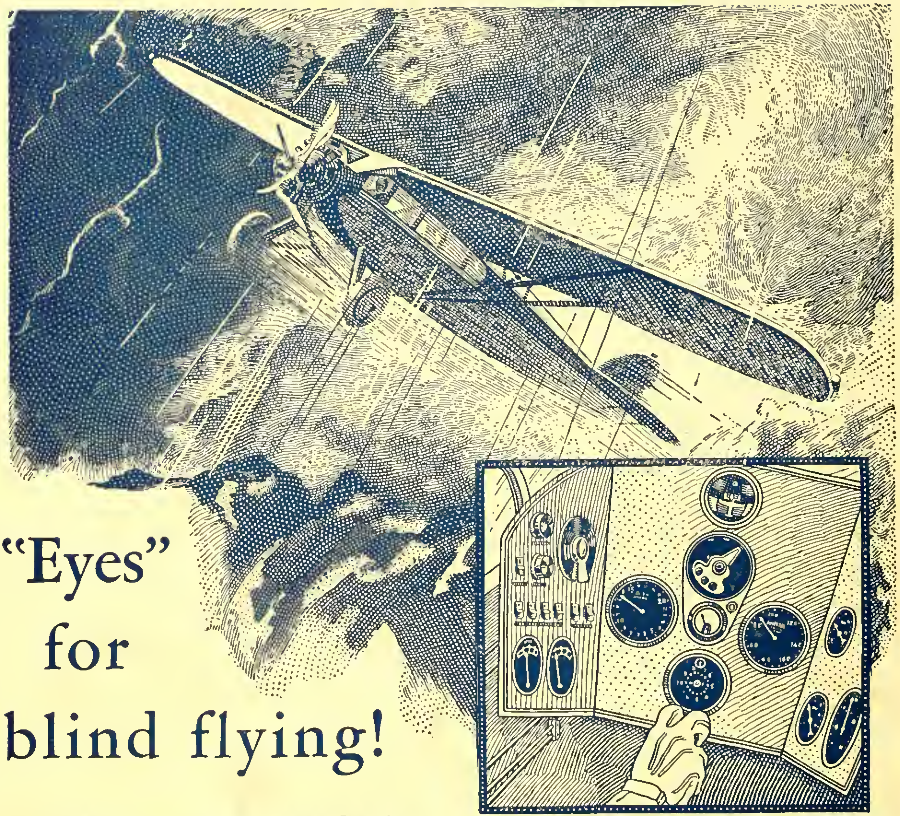
KOEHRING COMPANY
MILWAUKEE, WISCONSIN
Manufacturers of
Pavers, Mixers—Gasoline Shovels, Pull Shovels, Cranes and Draglines
Division of National Equipment Corporation

KOEHRING

They Save Time and Money

This photograph, taken in one of the principal cities of Europe, shows clearly what an Ingersoll-Rand Portable Compressor and 6 Paving Breakers will do in a few hours' time. Because of their labor-saving features, these outfits have replaced hand methods in almost every country of the world.

INGERSOLL-RAND CO.
11 Broadway - New York City



"Eyes" for blind flying!

Three new G-E contributions to the conquest of the air

LINDBERGH, flying blind much of the way, hit Ireland "on the nose" as he winged toward Paris. Now, as an aid to air navigation comes the magneto compass, a product of General Electric research, which gives pilots a navigating instrument of extraordinary accuracy.

Meanwhile, two other General Electric contributions to aviation have been developed—the electric gasoline gauge and the radio echo altimeter. The ordinary altimeter shows only height above sea level. The radio echo altimeter warns the pilot of his actual distance above ground or water by flashing green, yellow, and red lights on the instrument board.

Every year hundreds of college-trained men and women enter the employment of General Electric. Research, similar to that which developed "eyes" for blind flying, is one of the many fields of endeavor in which they play an important part.

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 9 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

95-713DH

GENERAL ELECTRIC

The ARMOUR ENGINEER

VOL. XXI. JANUARY, 1930 NO. 2

Published Quarterly by the College of Engineering
Armour Institute of Technology
Chicago, Illinois

Member of Engineering College Magazines Associated

Rock Drills

The world's greatest mining, tunneling, and road-building jobs have depended, to a large extent, upon the air-driven rock drill, one of which is pictured above. Most of these projects would have been impossible without some mechanical agent for the drilling of rock.

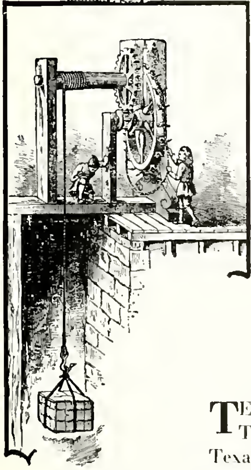
Ingersoll-Rand introduced the first practical air drill, and has fostered its development and application for almost 60 years.

INGERSOLL-RAND COMPANY
11 Broadway • New York City

Ingersoll-Rand

R-1949

SMITH-YOUNG-TOWER BUILDING, SAN ANTONIO, TEXAS
Atlee B. Ayres — Robert M. Ayres, Architects



One of the early phases of Vertical Transportation

A New Skyscraper in the Southwest

TEN Otis Elevators of Signal Control and other types provide Vertical Transportation in the Smith-Young-Tower Building, San Antonio, Texas. This structure is one of the outstanding office buildings of the Southwest and its Vertical Transportation system is fully in keeping with other features of advanced design and construction.

OTIS ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

WHAT YOUNGER COLLEGE MEN
ARE DOING WITH WESTINGHOUSE

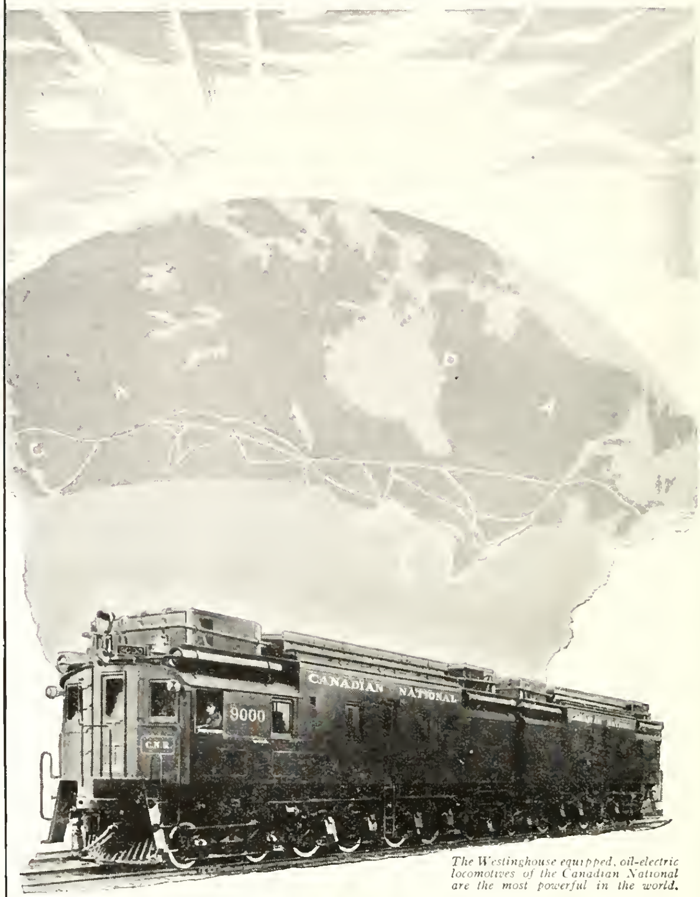
A. R. NELSON
Testing Engineer
Iowa State College, '25

H. R. MICHEL
Engineer of Purchases
Montana State College, '20

H. B. MAYNARD
Supt. of Production
Cornell, '23

J. A. WILSON
Headquarters Sales
Drexel Institute, '25

I. R. CUMMINGS
Application Engineer
University of Illinois, '21



The Westinghouse equipped, oil-electric locomotives of the Canadian National are the most powerful in the world.

The steam locomotive has a new rival

Attention in railway circles focuses this year on a spectacular undertaking by the Canadian National Railways—the electrification of certain trains on non-electrified lines.

One great oil-electric locomotive is already in service. The largest and most powerful of its type in the world, this giant electric locomotive that carries its own generating plant develops 2660 horsepower, uses only .43 lb. of fuel per horsepower-hour developed at full load.

Many interesting features are incorporated in its design. The speed and voltage of the engine-generators are automatically controlled by the power demands. The engine exhaust is directed through automatically regulated economizers that heat the coaches and serve as well as mufflers. Control is placed at both ends, to enable running in either direction. Only in a difference in gearing need the passenger type units differ from those adapted to freight service.

In the development of this locomotive Westinghouse engineers co-operated with the Railway's own engineers and leading locomotive manufacturers and frame builders. Every year hundreds of important jobs in which electricity is involved are delegated to Westinghouse, the clearing house for electrical development.

Westinghouse

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

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VOLUME XXI JANUARY, 1930 NUMBER 2

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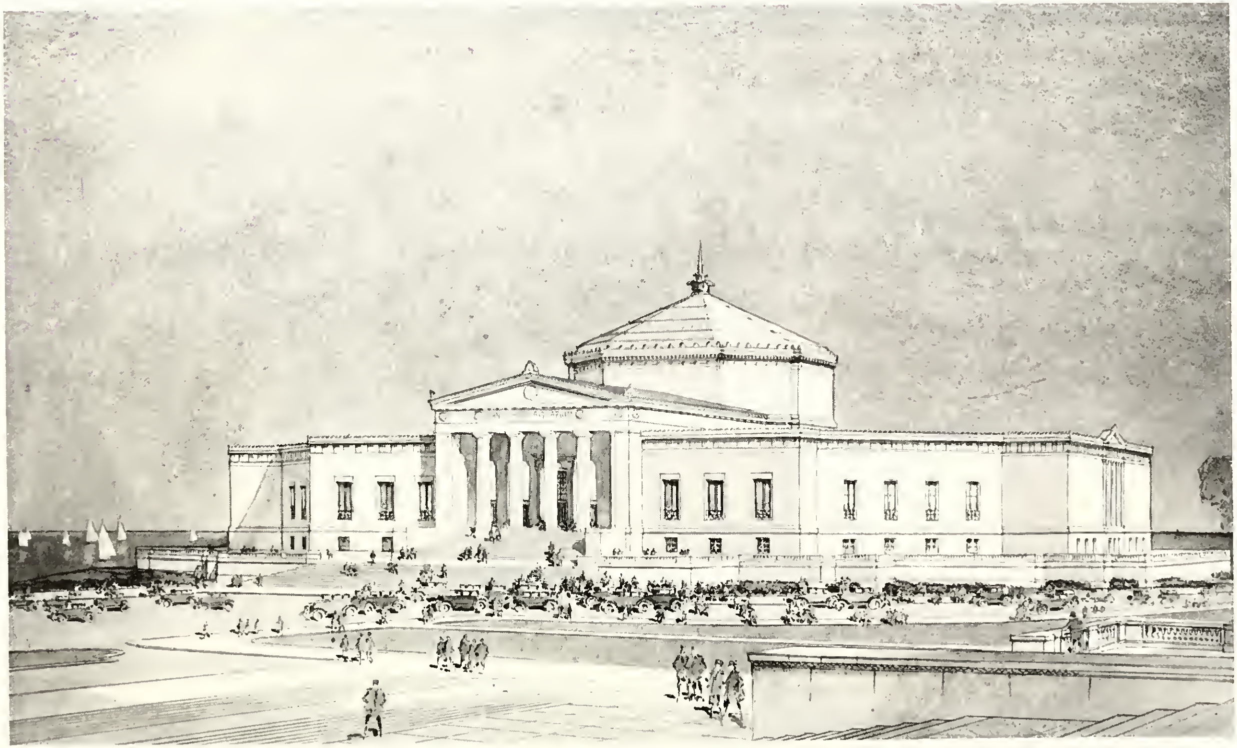

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The
ARMOUR ENGINEER

VOLUME XXI JANUARY, 1930 NUMBER 2

INVESTIGATION OF FIRE HAZARDS OF FILM

***By* David T. Smith, '30**

Student in the Department of Fire Protection Engineering

ONE of the most interesting problems before the fire protection engineer of today is the safeguarding of the hazards involved in the use of photographic film. The amount of photographic film and plates used in this country and throughout the world is enormous. According to an official of the company which holds a virtual monopoly of the manufacture of this product, the Eastman Kodak Company, their sales for the world market, for one year are about $200,000,000. This company produces about 75 per cent of all the film in the world, and about 90 per cent of the film in the United States. This will give some idea of the size and importance of the film industry.

The Underwriters' Laboratories, of this city, has done some very important and comprehensive work in the investigation of the hazard of photographic film. An account of the work accomplished is given in number 9-10, volume 10, of the "Laboratories Data" published October, 1929, by the Underwriters' Laboratories. A more complete and detailed report will be published by them in the near future. In the limited space of this article, a few of the more interesting features of the work will be described, together with the conclusions at which they have arrived.

There are two types of photographic film used in the country today, cellulose nitrate film and cellulose acetate film. The former is extremely hazardous; the latter is comparatively nonhazardous. Several serious fires have occurred in recent years from the use of the cellulose nitrate film, one of the most tragic being the fire at the Cleveland Hospital Clinic in Cleveland, Ohio, on May 12, 1929. In this one fire, scores of people were killed.

The hazards of cellulose nitrate film have been known for years. The National Fire Protection Association in cooperation with a number of manufacturers of this product, worked out regulations for the handling and storage of inflammable film, which have been in use for many years.

The need for a non-inflammable and especially a non-poisonous photographic film, was very forcibly brought to our attention by the Cleveland Clinic disaster, in which 124 persons lost their lives. It was the deadly fumes from the burning X-ray film that was responsible for this tragedy. The article herein presents a solution to the problem.

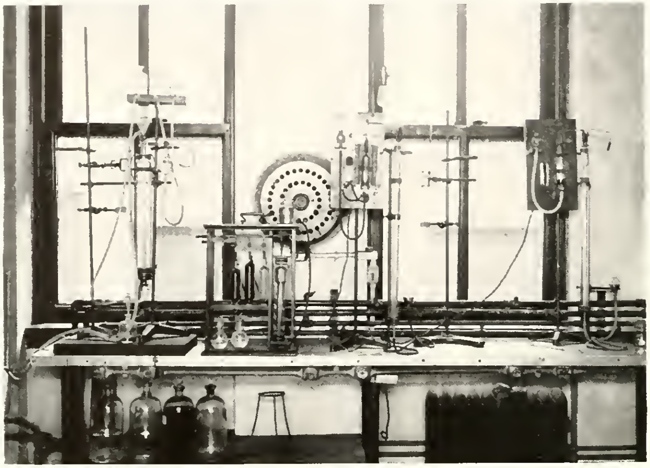
—The Editor.

The dangers involved, in the use of cellulose nitrate film, are many. This film has an extremely low ignition temperature of decomposition, an exothermic decomposition with evolution of extremely poisonous and explosive gases which when decomposing causes a serious menace to life.

According to A. H. Nuckolls, chemical engineer at the Underwriters' Laboratories, cellulose nitrate will decompose at a temperature of about 300 degrees Fahr. Tests performed at the Edgewood Arsenal by the Chemical Warfare Service show that large quantities of cellulose nitrate, tightly packed, will decompose at temperatures as low as 230 degrees Fahr. Once decomposition has started, the amount of heat given off tends to raise the temperature of the film until the ignition point is reached. The danger point is thus reached when the temperature is that at which decomposition starts. The extreme lowness of this danger point as compared with other substances, will be realized when you remember that wood has an ignition temperature of 600 or 700 degrees Fahr. and wood will not decompose below this temperature. Steam radiators, electric lights, and other common suppliers of heat may thus cause decomposition of cellulose nitrate film. The heat of combustion of nitrocellulose is 6,000 to 8,000 B. T. U., being about the same as that of wood, but the rate of combustion is twelve to eighteen times as great as that of wood. This causes the temperature attained by the combustion of cellulose nitrate to be much higher than that attained by other substances commonly encountered.

The amount of air present largely determines the characteristics of the combustion of cellulose nitrate. "When cellulose nitrate film burns freely in an excess of air, it evolves carbon dioxide gas, nitrogen gas, and water vapor, none of which are poisonous." On the other hand, when it burns or decomposes, with or without flame, in a restricted supply of oxygen, the gases given off are chiefly carbon monoxide, nitrogen dioxide, and nitrogen tetroxide. Some oxygen gas is evolved which supports further decomposition and combustion so that it is combined in one of the above forms. Hydrogen, methane, and traces of hydro-cyanic acid gas are also evolved. The proportions of carbon monoxide, oxides of nitrogen, and hydrogen evolved depend on the conditions. The carbon monoxide and oxides of nitrogen are very poisonous. The disastrous results of the inhalation of these gases at the fire at the Cleveland Clinic last May are but typical.

While the safest known methods of handling cellulose nitrate film should be employed, the greatest hope of the solution of this problem appears to lie in the preparation of a film without these dangerous and undesirable properties. A film having a cellulose acetate base instead of a cellulose nitrate base has been known for the past twenty years. It was tested by the Underwriters' Laboratories at its inception and found to be relatively slow-burning and non-hazardous, its fire hazard being listed as about that of news-print paper. Because of certain defects in the film in the early days of its production, such as a tendency to crack, a yellowish color and a lack of durability, this product was never widely used. Recent improvements in quality by manufacturers have again brought this product before the public. The cost of this type of film is still somewhat higher than the cellulose nitrate film, but with quantity production, on a scale comparable to the production of nitrocellulose film, similar prices should be available. The cellulose acetate film is used quite generally now for amateur motion picture work, and in projectors of the nonprofessional or miniature type which may be operated outside of a standard booth.



Apparatus for analysis of gases from film fires.

Details of the processes of manufacture of cellulose acetate film are still kept secret. In a general way the preparation consists of treating purified cotton or other sources of pure cellulose with acetic anhydride and sulphuric acid; washing, drying, and dissolving by chlorinated solvents in mixing machines. Special and usually secret treatments with ingredients to produce plasticity are then given and the final compound is rolled into sheets. The method of removing the yellow tinge is also kept secret.

The rather exhaustive investigation at the Underwriters' Laboratories of the nature of the products formed from film with cellulose acetate base under fire conditions has been done chiefly by Doctor C. A. Tibbals, Professor of Analytical Chemistry at Armour, in his position as Special Chemist to the Underwriters' Laboratories. In the investigation of cellulose acetate films by Dr. Tibbals, unexposed films were secured from the open market. Tests were planned and carried out with a view to ascertaining the exact nature of the gases evolved under conditions likely to be met with in practice. Included in the investigation were a few tests made with cellulose nitrate films for the purpose of direct comparison, and particularly tests bearing upon the possibility of the formation of the highly poisonous phosgene gas, when fire extinguishing liquids consisting essentially of carbon tetrachloride are applied to nitrate film fires.

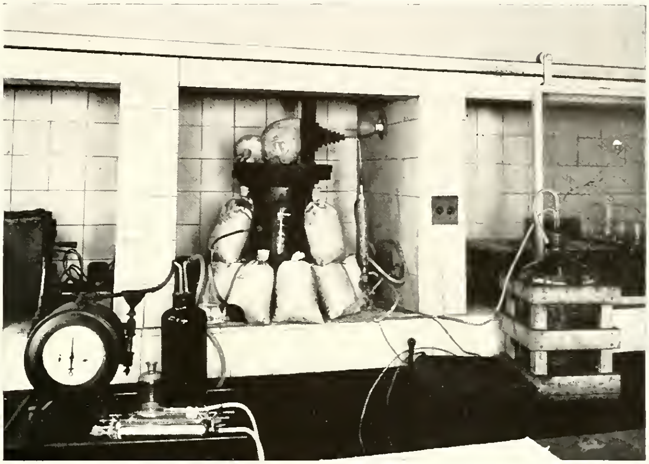
The tests made upon acetate film included burning tests in a specially designed chamber in which samples of unexposed, and exposed, developed, fixed, washed, and dried film, were ignited and burned under controlled conditions as regards temperature and air supply. It was sought to cover the range of combustion between free burning with abundant air supply, to the slowest burning in the most restricted air supply possible for the maintenance of combustion.

The test chamber with its auxiliary apparatus is shown in the picture below. The chamber itself may be seen in the middle of the picture surrounded by sand bags to insure safety in case of violent explosions. A supply of compressed air, controlled by a needle type throttle valve, first passes through the meter shown at the left, then through a chamber consisting of dark bottle, shown just to the right of the meter, and then to the bottom of the combustion chamber. The samples of film were hung up side by side, as ordinarily encountered in practice, also hung up in envelopes, and in other different ways for purposes of comparison. The gases of combustion passed off through the exhaust chimney in the top. A connection was made to the interior of the chamber at the left side in the middle by means of which samples of the gas could be withdrawn for analysis. At first, gas samples were collected by means of water filled flask and rubber bulb. The depression of the bulb drew water from the flask. This created a vacuum in the flask, drawing the gas sample in from the chamber. A later and more accurate method used was to take a sample tube with a petcock on each end, exhaust it to a pressure of only a fraction of a m.m., and insert it in the connection by merely opening and then closing the cock on the end towards the chamber.

Samples of the gas were also obtained from the chimney pipe. A connection was made, as can be seen on the right hand side of the pipe, to a condenser. This separated out the condensable products. One leg of the "T" connection to the outlet of the condenser allowed individual samples to be taken off during a test, while the other led to a large collection bottle. This was in connection to the chamber at all times during the run, thus taking an average sample during the run.

During each of the tests, samples of the products formed were withdrawn at intervals. The gaseous products were analyzed quantitatively, and the liquid and solid products, the condensed smoke, were identified.

"Special care was taken to ascertain the presence or absence of cyanides. Consideration was also given to the bromine content of the unexposed or undeveloped film, since the film contained about 0.43 ounces of bromine, present in the form of about 1.0 ounce of silver bromide per pound of unused film. Since the processes of exposure, development, fixing and washing remove practically every trace of silver bromide, leaving only metallic silver in the gelatine emulsion, bromine cannot be a factor in connection with stored film records."


Burning test chamber with apparatus for collection of products of combustion.

Other tests made were the determination of the volume of gas evolved when a unit weight of acetate film is decomposed by heat, together with observations upon the behavior of the material when heated. As the slow burning of film in a restricted supply of air approaches dry distillation in results, destructive distillation tests were made with the identification of products formed.

Among the results of the tests upon the cellulose acetate film were:

"About one cubic foot of gas per pound of film is formed under the influence of heat in the absence of air. The decomposition begins at a relatively low temperature and ceases promptly when the source of heat is withdrawn. At about 270 degrees C., inflammable vapors are given off.

"There was no significant difference in the behavior of unexposed film, film that had been exposed, developed, fixed, washed and dried, and film with paper as ordinarily filed. All smoking or fuming ceased promptly when the flame went out. Residues after test consisted of unburned film and charcoal. When combustion was slow in the most restricted air supply possible, heavy fume was emitted, with a pungent and offensive odor. Small amounts of tarry acid liquid were condensed from the fume which seemed identical with the liquid formed in destructive distillation. A very little bromine was found in the gases from unexposed film, though no trace of course from used film. No trace of cyanide was found in the gases in tests especially designed to detect this gas. Analysis of the water in soluble gases collected periodically throughout each test showed normal products of combustion, the quantities of carbon dioxide and carbon monoxide being at a maximum when the air supply was minimum, the percentage of oxygen being correspondingly low."

A few tests using cellulose nitrate X-ray film were carried on at that time under exactly similar conditions as regards equipment, size of samples of film, method of ignition, etc., as those used in the testing of the acetate film. Results were in accordance with existing knowledge of the behavior of nitrate film under such conditions.

"The film sample ignited very readily with no air supplied to the chamber, the flame soon went out, but rapid decomposition of the film, with the evolution of orange-red colored smoke, followed the extinction of the flame and continued until nothing of the original sample but charcoal remained. The fumes contained large quantities of the highly toxic oxides of nitrogen, such as NO, NO_2, and N_2O_4, and of carbon monoxide."

The results of these investigations conclusively show the merit of employing cellulose acetate films in place of cellulose nitrate films, because of reduced danger to both life and property.

These tests confirm the previous conclusions that cellulose acetate film is in the class with ordinary news-print paper in respect to hazard to health and life, from its smoke and fume in a fire, and also its fire hazard.

"The ignition temperature of cellulose acetate is between 700 and 800 degrees Fahr., as compared with the 300 degrees Fahr. for cellulose nitrate. The temperature of decomposition is about 500 degrees Fahr., at which temperature it gives off fumes in material quantity. The decomposition of cellulose acetate is, however, not exothermic, and therefore will not continue towards ignition without the addition of heat from an external source. Therefore, the temperature of decomposition is not a great factor from the standpoint of fire hazard."

All cellulose nitrate film should be kept in approved cabinets and vaults, properly vented and with sprinkler protection where possible. The extremely high temperature attained by combustion of cellulose nitrate film makes it very difficult to control. Smothering of cellulose nitrate film fire causes the production of the toxic and poisonous oxides of nitrogen, described above. Firemen are very reluctant to enter a building in which are burning quantities of this film. All these things go towards making the fighting of a cellulose nitrate film fire one of the most difficult situations of all those which a fire department must face. Automatic sprinkler systems, if equipped with quick operating devices such as deluge valves, and if especially designed for the situation, are effective. A larger number of sprinkler heads per unit area of space protected are necessary so that large quantities of water may be applied quickly. The fact that fires of this type of film are often of a semi-explosive form places even the best sprinkler system at a disadvantage.

Because of the relatively slow burning nature of the cellulose acetate film as compared with the cellulose nitrate film, it may be readily extinguished by water or by smothering. Standard hose streams, sprinkler systems, and

(Continued on page 78)

ROASTING OF METALLURGICAL ORES

By **Vernon A. Sturm, '30**

Student in the Department of Chemical Engineering

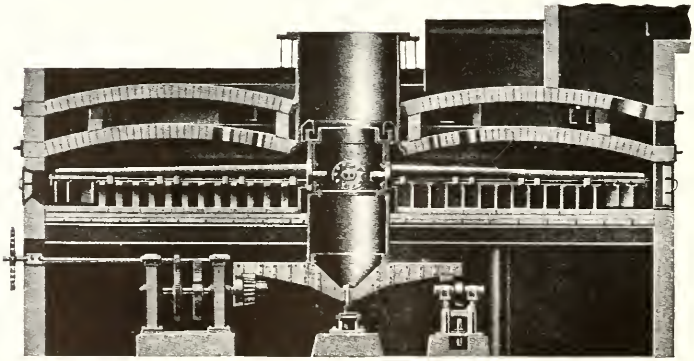
MOST metals do not occur in the earth's crust in the native or metallic state. The exceptions to this rule are: gold, which commonly occurs in this form; copper, which is found metallic in one important deposit (Michigan and in small amounts elsewhere); silver, mercury, and bismuth. The metals, copper, lead, zinc, nickel, antimony, mercury, bismuth, and molybdenum are obtained chiefly from sulphide minerals, while iron, tin, aluminum, chromium, tungsten, and manganese are obtained chiefly from oxide minerals.

To obtain pure metals it is necessary to separate them from the elements with which they are combined in the form of minerals and also from other elements which occur in associated minerals. Sometimes it is necessary or possible to extract a metal from its ore by the use of a chemical solvent, such as an aqueous solution of sodium or potassium cyanide for many gold and some silver ores, or an acid solution for a few types of copper and zinc ores.

In most cases extraction is obtained by fusion, sometimes preceded by heating the ore to a red heat in the presence of air to burn off all (or part) of the sulphur. The fusion results in concentrating the metal sought into a heavy constituent, either an impure metal or a compound with sulphur, called matte, which sinks to the bottom of the furnace. Upon this floats a light constituent called slag and contains the substances to be eliminated combined with each other as a complex silicate. It is obvious that if a low-grade ore is fused directly the slag will be the chief product of the furnace. Much heat will be lost in fusing this waste substance and furthermore since it is impossible to prevent some of the valuable constituents from entering the slag a serious loss takes place if the slag volume is large.

It follows from the above that it is desirable to obtain a separation of minerals before fusion, thereby obtaining the following advantages: (1) greater furnace capacity based on output of metal sought; (2) low slag volume with consequent saving in metal losses in slag. This process of separating the minerals is known as concentration or ore dressing which precedes roasting. The roasting process is performed on sulphide ores or sulphide concentrates to remove all or part of the sulphur contained therein. Oxide ores do not require this treatment.

Primitive man obtained his metals from furnace deposits where the minerals were native metal oxides or carbonates. Heating these with charcoal produced a metal by simple fusion or reduction. At greater depth sulphides were encountered and it was discovered very early that heating these in air converted them to a form where they could be reduced to metal by the same methods as were used on surface ores. This operation is called roasting. At first roasting was practiced using lump ores in heaps in the open air. Later, sides were built producing "stalls," then a top was added producing "kilns," and subsequently with the advent of concentration furnishing finer products to be roasted, various types of apparatus were developed until the present multiple hearth roaster became standard.



A thirty-two foot diameter, single hearth furnace. This furnace may be directly fired with top muffle effect, or fired in top muffle.

Roasting in metallurgy is defined as heating with an excess amount of air and is the process required for economical handling of low-grade ores which require roasting prior to smelting. The oxidation in roasting usually effects decomposition of a sulphide by removing sulphur from it, the sulphur passing off chiefly as sulphur dioxide gas. There are several methods of roasting which are, oxidation, reduction, chloridizing (treatment by using common table-salt), sulphatizing, etc., and roasting for special processes of treatment, for instance, the preparation of an ore for magnetic concentration.

Instead of the usual object of removal of sulphur, roasting may be practiced with one or more of the following objects:

1. Removal of a readily oxidizable and volatile element other than sulphur, such as arsenic, antimony, selenium, etc.

2. Changing of the chemical form of one or more of the constituents without removal of them.

3. Removal of moisture from the ore. When it is the only object of heating, the process is simply one of drying instead of roasting.

4. Agglomeration of finely divided ore into lumps or caked material. When such agglomeration is accomplished by heating, it is due to a softening, which is an incipient fusion without actual melting, of the fine ore particles causing them to stick together. This agglomeration by means of heating is called sintering, and the caked product resulting from the process is known as the sinter. Sinter consists of porous masses of material of varying size, and is in excellent condition for smelting. The sintering action may be the only object in view, but if sulphur is pres-

ent the sintering will be accompanied by roasting. Often the roasting and sintering are alike desired, and the double operation may be called roasting-sintering; some types of roasting furnaces accomplish sintering and some do not. The sintering action is sometimes brought about in rotary kilns, with the result that the softened, sticky particles are rolled into small balls. This modification is called nodulizing.

The conditions, in general, to be aimed for in roasting are:

1. Ready access of air to all particles of ore. In order that all the particles come in contact with air, the device of rabbling, *i. e.*, stirring of the ore, is used to accomplish this purpose. Rabbling may be done by hand, but most modern furnaces are provided with some mechanical means for doing this or has some substitute for the operation.

2. Control of temperature. It is the best practice to have the ore heat up slowly, and in some furnaces this is accomplished by having the charge enter at a relatively cool part of the furnace and gradually progress to the hottest part where the roasting is performed. It is also essential that the maximum temperature be below the melting point of the ore. If the temperature should be above the melting point of the ore an actual fusion would be caused and would bring the charge into a compact form which would prevent thorough access of air. It would also cause a smelting of the ore which would not be desired.

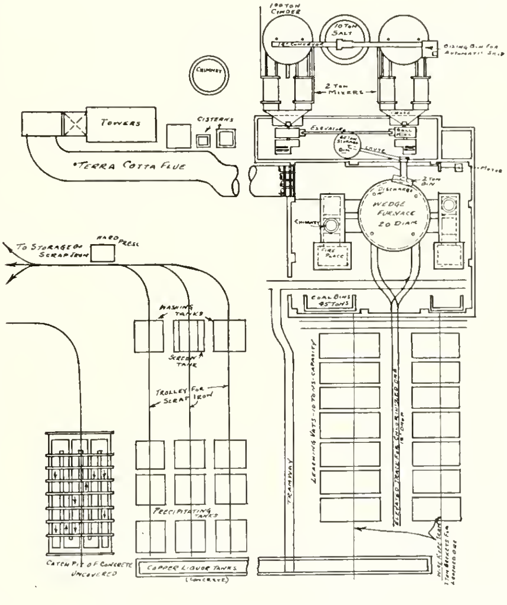
3. Economy of fuel. In this connection it should be pointed out that the roasting reaction itself is a generator of heat. Accordingly, the amount of fuel needed for roasting is, in general, small. Just what quantity is required depends upon the amount of sulphur in the ore, the amounts of the different elements oxidized, the rate of roasting, and the design of the furnace. Often no fuel at all is needed, except just enough to ignite the ore.

4. Economy of labor, or ease of handling. This factor is of much more importance than it was some years ago; it has become a prime consideration in roasting processes.

The different methods of roasting may be classified as follows:

I. Heap Roasting
II. Stall Roasting
III. Roasting in Furnaces
    A. Hand-operated Furnaces
    B. Mechanical Furnaces
        1. Natural-draft Furnaces
        2. Blast-roasting Furnaces
            a. Up-draft
            b. Down-draft.

The usual object of roasting is to eliminate sulphur present, either partially or wholly. When the sulphur is entirely removed the roast is known as a "dead" or "sweet" roast. Dead roasting is essential where the metal is to be completely oxidized as in a pyrite ore, where the iron sulphides are converted into iron oxide. Copper requires sulphur in smelting and therefore when roasting copper ores of high sulphur content, enough is left to smelt the ore. Certain gold ores such as telluride ores containing a small amount of pyritic minerals along with the gold are usually roasted preliminary to leaching with alkaline cyanides for the purpose of extracting the gold. The object here is to form telluride of iron and thereby leaving free gold.



The layout of the Longmaid-Henderson plant. The process here shown is used for chloridizing copper ores.

The object for the use of the oxidizing roast is dependent upon the metallic ore being roasted, according to its content and condition. Iron ores are roasted to form iron oxides, while copper ores are roasted to oxidize the sulphur and iron and remove the volatile constituents. The temperature at which the oxidizing roast is carried controls the rate and extent to which the sulphur is removed. This temperature largely depends upon the type of mineral being roasted and in most cases it is carried on at a bright red heat. In roasting zinc ores, zinc sulphate gives up only part of its sulphuric acid, forming basic sulphate, which is completely decomposed to zinc oxide, sulphur dioxide, and oxygen, when carried on at a white heat.

Reduction roasting implies a heat treatment of an oxidized metallic compound under the influence of a reducing agent such as active hydrogen, carbon, or a metallic sulphide at a temperature below that of fusion, for the purpose of lowering the oxide condition, or for the purpose of completely reducing to metal. Such an instance of reduction to the metallic state is the production of mass copper from roasting high-grade matte.

Sulphatizing roasting occurs during oxidizing roasting, but is essentially the reverse process, since the efforts are to produce the maximum amount of sulphate of the metals by coordinating the temperature and the relative proportion of oxygen and SO_2 in the furnace gases. The muffle furnace is the one best suited for this purpose. Catalytic action plays an important part here, as it has been found that iron sulphate helps to sulphonate copper oxide. Complete sulphatization depends not only upon the temperature but also upon the correct sulphatizing atmosphere. The temperature for sulphatizing ores is from 500 to 590 C. and ferrous sulphate will be completely broken up and cupric sulphate is decomposed if the temperatures rises to 580 to 700 C.

Chloridizing roasting and the recent chlorination processes are identical, *i. e.*, the roasting of the prepared ore with a chloride, usually common table-salt, to convert the original mineralogical form of certain metals to their chlorides. The chemical reactions of the chloridizing roast is very complex and not definitely or thoroughly known.

(*Continued on page 68*)

ZRS—4 AND 5, AMERICA'S MONARCHS OF THE AIR

By **F. H. Bigelow, '30**

Student in the Department of Electrical Engineering

THE United States Navy has contracted for the construction of two airships that will surpass in size anything that has been attempted before in the way of aircraft. The first of these sister ships, to be designated the ZRS-4, will be about twice the size of the Graf Zeppelin in cubical content and about 35 per cent larger than the R-100 recently completed in England. Compared with the U. S. Airship "Los Angeles", it will be about two and one half times as large.

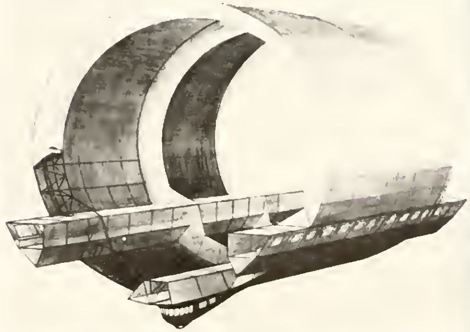
The modern tendency in airship design is to make the shape of the ship appear shorter and fatter. Consequently the American ZRS-4 will only be 15 feet longer than the Graf Zeppelin while having nearly twice the gas capacity. The American ship is, however, 34 feet greater in diameter, giving it an aspect ratio of 5.9, as against the 7.7 of the Graf. That is to say, the American ship will be about six times as long as it is thick.

The triple-layer principle of construction is used, that is, the hull consists of a rigid framework to withstand the major stresses from the loads carried and the aerodynamic forces; the gas cells within to retain the lifting gases; and a taut fabric outer cover treated so that it is weatherproof and will offer a smooth flying surface.

The framework of the ship is composed mainly of transverse rings connected by longitudinal girders, the latter extending from nose to tail. These so-called rings are, over most of the length of the ship, 36-sided polygons, with their corners connected by the longitudinal girders. The transverse or ring girders are of two types—main and intermediate. The main rings consist of two outer annular rings connected by cross-girders, in zig-zag fashion, to an inner annular ring, forming a triangle. These ring girders are large enough to form corridors for crew members to climb entirely around the circumference of the ship, making it possible to closely inspect every part of the ship even while in flight. These main rings are spaced about 74 feet apart, the gas compartments being set between them. The intermediate rings are of the single girder type and are spaced between the main rings—usually three to a compartment.

The longitudinal girders run from one end of the ship to the other, connecting the ring girders and forming the longitudinal ridges that are seen from the outside of the completed ship.

Unlike other ships of this type, there are three corridors running the length of the ship, one running along the top center line and the other two placed symmetrically in the lower part about 45 degrees from the vertical. Previous ships have only had a single "cat walk" running along the bottom of the ship. The three corridor plan, however, aids greatly in maintenance and inspection.



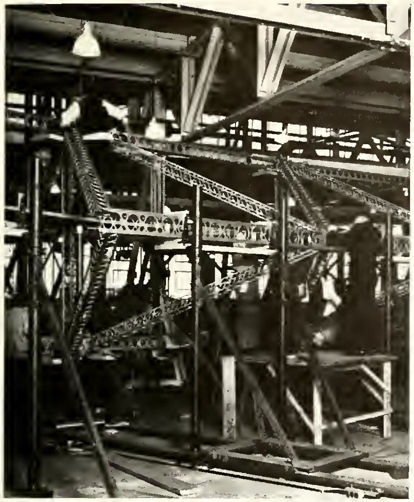
A section showing the construction of the shell of the airship.

The steering of the ship is done by means of control surfaces arranged in pairs near the stern of the ship. The main fixed section gives stability to the ship, and the hinged after-sections or rudders give it altitude and direction control. The fixed sections are rigid in themselves, being made of triangular cross-section girders the same as used in other parts of the ship. The rudders are controlled by cables from the control car. Balancing vanes are used to reduce the large forces that would be required to steer such a large craft.

These Navy ships have been designed to take full advantage of the monopoly the United States has over the world's supply of helium. This inert gas is non-inflammable, and therefore, precautions that had to be taken in the construction of former ships, did not have to be adhered to in planning the location of the engines and the living quarters of the crew. In the American ships the motors will all be housed within the hull with only the propellers extending outside the ship. This will provide a roomy engine room where the mechanic may repair and maintain the engine without making a perilous descent to a small cramped engine gondola suspended beneath the ship as is done in all existing models. Placing the engines within the hull has reduced the resistence the ship offers to the airstream. Also the placing of the living quarters within the hull reduces the parasite resistance so that the speed of the ship is materially increased.

The control car, to provide perfect visibility, must necessarily be placed outside the hull. It is an integral part of the structure placed forward and projecting below the streamline of the lower half of the ship. The car is made only large enough to accommodate the commander and his staff and the numerous navigating instruments that are necessary in the operation of the ship. The radio cabin and commanding officer's quarters are placed directly over the car inside the hull.

One of the unusual features of the design of the Navy airships is the provisions made for the storage of five completely assembled airplanes. A storage compartment, about 75 feet long by 60 feet wide, is located about one-third of the ship's length from the bow. Collapsible doors in the bottom of the ship cover a T-shaped opening through which a trapeze with an airplane attached, can be hoisted or lowered. The airplanes may attach or release them-



Preliminary work at plant before taking to new factory and dock.

selves during flight. Such a possibility greatly increases the scouting value of an airship and aids her in warding off an attack.

The power plant of the ZRS-4 will consist of eight motors that will develop 4,480 horsepower. They will propel the huge craft at a maximum speed of 83.8 miles per hour. The motors are placed four on a side and are connected to the propellers through a novel gear arrangement. Bevel gears at the outboard ends of rigid drive shafts, make it possible to use the propellers not only for thrust in a fore or aft direction (the engines themselves being reversible), but also in a vertical direction by tilting the propeller axes through 90 degrees. This feature of tilting propellers will be of great importance in starting and landing maneuvers. The dynamic force of these propellers will also aid the lifting force of the gas in making an ascent with an extra heavy load.

Due to the fact that the helium gas is quite expensive, and the supply limited to only a few airship bases, all means possible are taken to prevent valving off any of the gas. When the ship starts on a long journey it is heavily loaded with gasoline and the amount of lifting gas must be sufficient to carry this load. As the ship progresses, however, the gasoline is used up and gas must be allowed to escape in order to maintain the same altitude. In the ZRS-4 means are provided for condensing the exhaust coming from the engine and the water obtained in this way used as ballast, making it unnecessary to waste any of the valuable helium. Due to the oxygen taken from the air in the combustion of gasoline, the exhaust gas contains water vapor in greater quantity than there was fuel burned. Passing the exhaust through pre-coolers and then through condensers reduces the vapor to water so that it can be pumped to tanks provided for that purpose.

The safety of this type of ship has been proven in the past by the achievements of the Graf Zeppelin in its remarkable flights. Improvements in the ZRS-4 make it even more dependable. The structural strength of the ship has been made to withstand violent maneuvers of the rudders, flying at excessive angles of pitch, or flying into strong gusts. The duplication of every vital part increases the reliability; the triple-layer hull, the twelve gas cells, and the eight motors all increase the factor of safety. Although using an inflammable gas, elaborate precautions are taken against fire. Fire proof walls around the engine rooms, ventilation of the entire ship to prevent accumulation of gasoline fumes, gas-tight electrical connections all reduce the fire hazard from within the ship. Every piece of metal in the ship is bonded together. This forms a Faraday cage that will dissipate an electrical charge so that there is little danger of damage by lightning.

The lifting gas in an airship expands and contracts due to changes in altitude, temperature, and barometric pressure. For any given trip, they know approximately what these conditions will be and calculate the amount of gas to just fill the cells completely for the maximum expansion. If, however, they should run into unusually low pressure areas the expansion would become excessive and there would be danger of bursting the cells if some safeguard was not provided.

This condition is met in the case of the ZRS-4 by providing over-pressure valves. Since the gas is lighter than air, the valves are located in the gangway at the top of the ship so that the gas may escape quickly. In the largest cells there are as many as four of these valves spaced along the top. Being located in the top gangway makes it easier for them to be inspected and kept in perfect working order than in any airship previously built.

They are so adjusted that they will open automatically when the expansion reaches a critical point, thus releasing some of the gas so the pressure on the cells will be reduced. At least one valve in each cell is mechanically controlled by means of cables from the control car. The commander may then release any amount of helium if the conditions of operation makes it necessary.

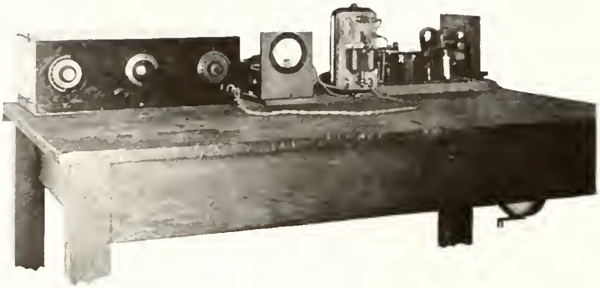
To house these great ships it is necessary to build a gigantic hangar. This hangar is now under construction by the Goodyear-Zeppelin Corp. of Akron, Ohio, who also are building the ships. The structure will be the largest edifice built by man. The floor space will be nine acres in area and will be covered by a single span roof, unsupported by any pillar or post. The building will be supported on rollers to provide for the expansion of the steel framework with temperature variation.

There will be four doors at the ends, oval shaped, similar to the shape of the skin of a quarter of a halved orange.

These huge orange-peel shaped doors supplant the straight vertical doors which are used in older airship docks in the United States and Germany. One of the major reasons for adopting this type of door construction was to reduce cross wind currents, which hinder airship docking and launching operations. When the orange-peel doors are opened they will fit closely along the sides of the dock, providing a full opening at the ends.

(*Continued on page 70*)

Working on master ring at the giant factory and dock at Akron, Ohio.



Remote control receiving layout, showing receiver, keying relay, and B supply.

REMOTE CONTROL BY RADIO

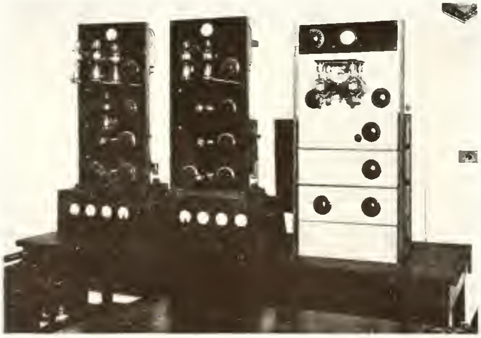
By Walter L. Filmer, '30

Student in the Department of Electrical Engineering

THE art of controlling apparatus by radio has always held a fascination for experimenters, for it has a strong spectacular appeal and offers unlimited opportunity for the application of ingenuity. Radio control at the present time has not only been applied to moving vehicles of all types but to stationary equipment, which has more value in the commercial field where it is being used in some instances and with success.

Relays have been operated for years by radio telegraph instruments but it was not until the development of the vacuum tube that their operation could be relied upon at any great distance. The basic principle of radio control is not complicated but as the current dealt with is very small the instruments must be sensitive to them but not so delicate as to be thrown out of adjustment by mechanical shocks It is this part that gives the most trouble but with the modern amplifiers the variation of the current has been increased until it can be effectively used.

The various systems of radio control can be divided into two general types which can be further subdivided. These two main divisions are those which use one receiver and those which use two receivers, of which the first is the most common even if the relay system is more complicated when several operations are to be performed. Those using one receiver can again be divided into those doing one operation and those doing more than one operation. The system using two receivers is only used where more than one operation is to be performed.

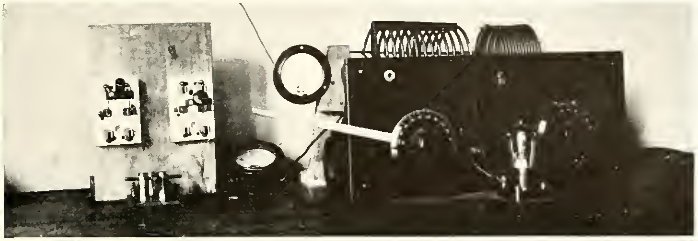


The three transmitters at the University of Cincinnati remotely controlled by radio.

The one receiver method is the most extensively used in the commercial applications today. At the present time there are several applications where it gives excellent service, which would not be possible otherwise. Off the coast of Scotland, at the entrance to the Firth of Clyde, there is a fog signal which is operated by radio control from a transmitter on the shore a mile and a quarter away. The apparatus is entirely self-contained and needs attention only once in three months for battery recharging and the replacement.

The largest field for remote control by radio is that of the electric power industry, as small sub-stations can be controlled directly from the central station. This has been done in a small town in Indiana where the power consumption did not warrant having an operator on duty all the time. The sub-station is supplied over two power lines and these two lines are used to carry the high frequency impulses which operate the radio control. The two lines are used so that in case of interruption of one line the sub-station could still be supplied and operated over the other line from the central station. The relay system is so arranged that all the operations performed by the operator can be done from the central station. Another application of radio control is being used in Glens Falls, New York, where the street lights are turned on and off by this means. At the power house is located a small transmitter operating on 7500 meters, which feeds its carrier wave over the power wires to the receiving stations, of which there are five. These receivers are tuned to the single wave and respond to the high frequency impulse and in turn, the electric relays are operated which turn on and off the street lights. The transmitter is only operated fifteen seconds each day, five seconds to turn on the lights and ten seconds to turn them off. The operation of the transmitter is practically automatic as there are switches designated as "on" and "off," which turn the transmitter on for the required length of time.

The operation of a radio transmitter by remote radio control is used at the University of Cincinnati in controlling their 400 watt crystal controlled transmitter located atop Swift Hall. This station is operated by any one of five smaller stations located within a radius of a few miles. The control transmitters consist of a five watt set constructed to be very stable in operation and accurate in the adjustment to wavelength.



The low power remote control substation, W8ALK.

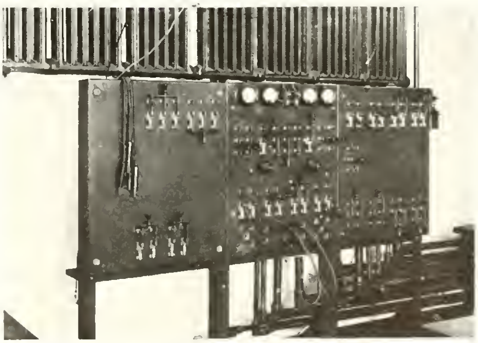
The heart of this system is an air-bellows relay having a delayed-time characteristic, and so adjusted as to open or close its contacts in about three seconds. The impulses sent out by the distant control transmitter operate the sensitive control relay, which in turn operates the keying relay and the delayed-time relay in series. Holding the key on the control transmitter down for three or more seconds causes the delayed-time relay contacts to close, which starts up the motor generator of the transmitter and turn on the filaments. The keying impulses are then transmitted by the controlled transmitter; as long as the incoming dots and dashes do not cease for more than three seconds the apparatus remains in operation. A lapse of three seconds causes the delayed-time relay to open and shut down the transmitter.

Another type of relay system is that which allows the selection of any one control at any time. This is the system that was used at the University of Illinois to control their demonstration car which was exhibited in the gymnasium. There were eleven controls and any one of them could be selected by sending a certain code letter, such as dot-dash-dot, from the transmitter. The letter "R" was assigned to the operation of starting the car in reverse, while "A," would start it ahead. To stop anything which might be in progress a single dot was transmitted which would release all contacts and shut off the driving motor.

The actual controlling mechanism consisted of fifteen relays, of the type used in telephone exchanges, mounted on a small frame work. There are eleven wires leading from the controlling mechanism each of which is connected to the piece of apparatus it is to control, and corresponds to a code letter. When a letter is received by the radio receiver it "sets up" the relays in such a combination as to connect the corresponding control wire to ground. This completes the circuit and the current to the piece of apparatus selected, which causes it to operate

The use of two receivers and two transmitters for operating the relays is not common, but it simplifies the construction of the relay circuit. One of the transmitters operates the selector switch, through a receiver, which selects the correct contact to do the operation required. The other transmitter, through its receiver, closes the relays and completes the circuit thus performing the operation. The transmitters must operate on different wavelengths, so each set will operate the relay it should and at the correct time. The time required in performing an operation is usually greater with this type as two keys must be used for transmitting the required signal.

So far in this article the only type of signal used for the operation of relays is the keying impulses but this is not the only type that can be used. The speaking of certain words into the transmitter has been used to operate the equipment connected to the receiver. This is not easily done as it requires considerable equipment which must be adjusted very accurately. The operation depends on the tone in which the word or words are spoken, so that it could only be controlled by those persons for whom the equipment was adjusted.



The power panel. The delayed time relay which is the heart of the system is at the end of the panel.

The use of different frequencies transmitted on the carrier wave is easily used. This is done by the use of filters on the output of the receiver. These filters are resonant circuits for the various frequencies used and therefore offer a low impedence to one certain frequency. The reception of this frequency will therefore cause the current through this filter to reach its maximum value which will be many times greater than the current through it at any other frequency. The relays can easily be adjusted to operate only on the maximum value of the current.

The use of radio control will increase rapidly as the equipment is perfected. Wired wireless will probably be used in most cases as there would be less interference from other transmitters. Using radio control eliminates the use of wires between the two points, which are not only costly to install but must be maintained.

The use of radio control in times of war is important as great damage could be done without endangering the lives of the operators. This has been known by both the army and navy for years and they have been experimenting with it, but the results of their experiments have not been made public at the present time. Several years ago the navy completely controlled one of their large battleships by radio and used it as a target for the other ships. Both the army and navy have been experimenting on radio controlled aeroplanes but the quick operation needed in landing and taking off is hard to obtain. The army has been using radio controlled tanks in some of its maneuvers.

The development of radio as an aid to aviation has progressed rapidly in the last few years. The two systems mentioned below could be used to control the plane directly but are used only to indicate to the pilot whether the plane is on the correct course or not, as the equipment to control the plane

(*Continued on page 72*)

THE ELECTRODEPOSITION OF RUBBER

***By* Julius Lichtenstein, '30**

Student in the Department of Chemical Engineering

IN 1925 a commercial method of depositing, electrolytically, rubber from a rubber solution was independently developed in Europe and in this country. Electro-deposition of rubber was first attempted by Victor Henri, in 1907, at Paris. He discovered that rubber particles in a water solution were negatively charged. Two years later Cockerell proposed to coagulate rubber electrically on a platinum moving belt, anodically connected. Clignett, in Java, soon after, attempted to utilize commercially the laboratory information in removing rubber from the latex solution, the rubber water solution from the rubber tree. The commercial process now used was developed independently from 1921 by two groups of workers; in America by S. E. Sheppard and L. W. Eberlin, and in Europe by Paul Klein of Budapest, Hungary.

Before entering into the details of the process, a short description of the properties of a latex solution are necessary. Natural latex as it comes from the rubber plant is an unstable water solution of rubber, which undergoes a rather rapid enzymatic and bacterial attack on the proteins. It has been found possible to preserve this solution so that it can be exported. Of the various preservatives ammonia has so far appeared to be most satisfactory and a concentration of two or three per cent has been found to be most suitable. The rubber content of a plantation latex varies somewhat with the age of the tree, but commercially obtained latex varies from 30 to 35 per cent rubber. Besides containing rubber, the solution has dissolved salts and sugars that occur with the latex. This foreign material interferes with the deposit of rubber and must therefore be taken care of or it will spoil the rubber plating. In this connection a typical analysis of Hevea latex follows in the table below:

Analysis of Total Solids.

Content	4 Year Old Tree	10 Year Old Tree
Water	70.0	60.0
Caoutchouc	27.07	35.62
Ash	0.24	0.70
Protein	1.47	2.03
Resin	1.22	1.65

When depositing rubber a number of difficulties are encountered. The rubber ion is negative and with it is deposited all other negative ions such as the hydroxyl ion and the other negative salt radicals in the water solution. The hydroxyl ion is the most abundant as it comes from the dissociation of water, the solvent. The water is dissociated on electrolysis yielding oxygen at the anode with the rubber and hydrogen at the cathode. The rubber will in all cases be either oxidized by the nascent oxygen and rubber will form on the anode. This deposit appears in a sponge-like form. To overcome these difficulties two effective methods have been developed.

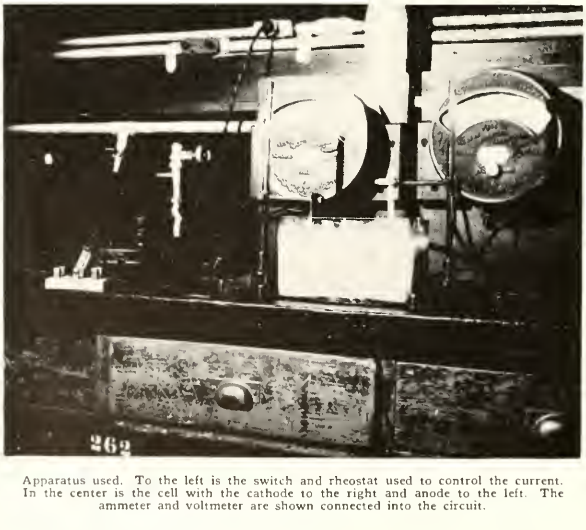
The first method makes use of an electrode that will react with the gases formed. Various metals have been used with more or less success. A zinc anode gives very good results and is used by some manufacturers in this country.

The second method consists of a porous cup with a metallic anode in the center. The rubber ion gives up its charge on the membrane, while the hydroxyl ion, being smaller than the rubber ion, continues through the porous cup and gives up its charge on the metallic anode. To aid the removal of the oxygen and other gases the cup may be connected to a vacuum line.

Rubber deposits on porous diaphragms, made of plaster of paris or porcelain, are of considerable practical importance. Molded articles may be manufactured by making diaphragms in the shapes desired and stripping them from the mold after deposition has taken place. The manufacture of inner tubes, pure gum articles of light single piece construction such as bathing caps, tobacco pouches, gloves, etc. are made by this process. Another important application is in the covering and impregnating of fabrics with rubber by electro-deposition. The fabrics need only be passed continuously over a revolving anode through a latex dispersion and proofed.

The cathode in both cases may be of any metal, such as iron or lead. The anode metal used in the porous cup is usually iron, although it may be any kind of metal; while in the other method, it is invariably zinc or lead, both giving excellent results.

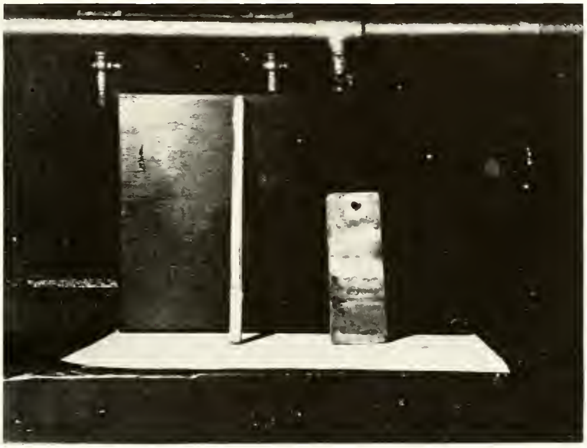
Anodic deposition of rubber alone would afford only a very limited application of the process. It is well known that rubber requires sulphur for vulcanization, also that the elastic and mechanical properties of rubber can be modified and controlled by the incorporation of various filters and finely divided solids. It is, therefore, of greatest importance that sulphur, filters, pigments, and softeners in finely divided form be mixed with natural and



Apparatus used. To the left is the switch and rheostat used to control the current. In the center is the cell with the cathode to the right and anode to the left. The ammeter and voltmeter are shown connected into the circuit.

artificial rubber latexes to form stable dispersions, so that the mixtures can be electrically deposited uniformly and substantially in the proportions of the mix.

These ingredients cannot be added to the solution unless they can be made to acquire a negative charge and remain dispersed, naturally or with vigorous agitation of the solution. If substances with a positive charge are added they migrate in opposite direction and tend to precipitate each other. Quantitatively, all that can be said is that the ratio of respective concentrations at which precipitation occurs varies very much; there are certain proportions in which solids must be mixed for complete precipitation, outside this range there is partial precipitation, within limits; while if either colloid is present in great excess no precipitation occurs. Other factors that enter are electrophoretic migration *i. e.*, migration velocities of the ions, variation in concentration during plating. All control the uniformity of plating, and the kind of ingredients that can be added.


The narrow rod is the zinc anode with a rubber deposit on it, while the other is the lead cathode. The rubber is elastic and free from blow holes.

After the desired ingredients have been deposited to the required depth, the anode is removed and washed free of the soluble sugars that exist in the latex. The rubber is then vulcanized under a steam pressure of about 20 lbs. The final rubber is a product far superior to the milled rubber. The tensile strength and elasticity are extremely high compared to other rubber of similar composition. A tensile strength of 5000 lbs. per square inch is readily obtainable, and an elongation up to 900 per cent of the original length is common. The electrical insulating properties are greatly improved over that of milled rubber due to the removal of the sugars that naturally remain in the latter product.

When writing about insulating properties of rubber, the question arises as to how a current can be maintained to give a deposit of any thickness. When a metal is deposited on a cathode the deposit is a conductor, therefore, metal will continue to deposit and adhere. But when one layer of rubber particles is deposited or discharged on an anode further deposits should stop, as rubber is a non-conductor. Instead a layer of any desired thickness is obtained. This is explained by the fact that the rubber deposited does not completely coalesce; a semi-permeable gel forms which is impregnated with the serum or intermicellar liquid. Such a deposit will continue theoretically as a conductor of electricity to an indefinite thickness. Practically it is limited by the question of drying and be secondary charges in the surface layers. The amount of water in the deposited layer depends upon the concentration of the latex, the conductance and nature of accessory ions, and the voltage and current density.

As part of the work in the senior electro-chemistry course, S. Schwartz and myself have conducted some experiments along the lines explained. A cell, as shown in the figure was arranged, containing a latex solution of 30 per cent rubber and about three per cent ammonia. The anode used was a pure zinc rod which was placed about six inches from a lead cathode.

Current densities varying from one to two amperes were tried and an instantaneous deposit of rubber of about one hundredth of an inch in thickness was obtained. The current density then fell rapidly until zero was approached. Increasing the voltage to 110 volts by stages, increased the current density for a minute or two but it then fell again. The conclusion reached was that when too high a current density is used to start a rubber deposit, a solid layer results that has a very high resistance.

When a current density of 0.2 amperes was used, a continuous deposit resulted for about an hour. The resistance of the cell at this time was a hundred ohms. The current then fell to 0.1 amperes where it remained for a considerable length of time, but later dropped to .05 amperes. At this point the electrodes were brought closer together and it was found that the current did not increase appreciably although the resistance of the intervening space was reduced. It was found that the resistance of the layer formed was high and that a heavier deposit could be obtained if the rubber was slowly deposited. This rubber deposit was easily removed from the zinc rod. It proved to be solid, free from air holes, elastic, and retained the form of the rod.

A series of experiments have just been started with filters and accelerators in the latex. As a result we expect to increase the conductivity of the cell and reduce the resistance of the deposited rubber by the addition of the ingredients mentioned. We are in high hopes of obtaining satisfactory results.

Wherever applicable, the process of electrodeposition of rubber offers a great economic advantage over the process of milling and spreading mechanically, principally by reason of the reduction of power and labor. Mixing and compounding of sulfur and other ingredients into the latex can be produced at greatly reduced cost by high speed mills. Electrodeposition is again cheaper than mechanical spreading and forcing. Generally, as has been shown, electrodeposition will have greater strength, other things being equal than mechanically milled rubber, since it has not been degraded by friction. The six general types of production by this method are:

1. Coating permeable non-conducting material other than fabric.
2. Coating impermeable non-conductors by metal spraying.
3. Preparing certain types of molded or dipped goods by deposition on metal forms and stripping.
4. Sheet rubber production by electrodeposition.
5. Coating metal surfaces with rubber, vulcanized either soft or hard and of variable thickness.
6. Impregnating and coating fabrics to any desired thickness.

Although the character of the metal

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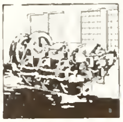


ENGINEERING NEWS

Steam Roundhouses

A recent and important development in the steam railroad industry is the construction of locomotive roundhouses with high pressure steam plants to recharge the locomotive with steam while they are at the terminal instead of building and maintaining fires in each individual locomotive.

Most roundhouses of this type use steam at about 225 pounds without superheat. In some cases, however, the steam is used at a lower pressure and superheated.

The latest installation of this direct steaming system is at Seattle, Washington, where a terminal has been built which has a roundhouse for storing 24 locomotives. Steam at 225 pounds is carried in a six-inch main from the power-plant to the roundhouse, and there branches into one five-inch main serving nineteen locomotive tracks and one three-inch branch serving five tracks.

In addition to the high pressure steam main there are three other pipe lines from the power house to the roundhouse. One of these lines is for blowing off the contents of locomotive boilers that are emptied in the roundhouse. Another line is for supplying fresh water at a pressure of 110 pounds for filling locomotive boilers, and the third line is for hot water to wash out the boilers. All mains are carried overhead. At each track they have a cast steel mixing chamber, in which the high pressure steam and hot filling water lines are connected together.

From the mixing chamber a flexible hanging pipe is provided for connection to the locomotive. This is connected to the blow-off cock in the bottom water leg of the fire box. When the overhead connection to the blow-off main is opened the steam pressure on top of the water in the locomotive boiler forces the water out through the blow-off main back into a separator, from which it is taken to a jet condenser.

If the boiler does not have to be emptied for washing out or repairs, a half-inch by-pass, or floating valve, is opened allowing the high pressure steam to flow past the main direct steaming valve and into the locomotive through the flexible pipe connection to the blow-off cock at a sufficient rate to maintain about 100 pounds pressure on the locomotive during the layover. A locomotive in storage in this manner can have its pressure boosted up so that it will have a working pressure in a few minutes.

All fires are extinguished before the locomotives are put in the round house and are not relighted until it has been moved out of the house.

River Made to Flow Underground

In 1924, the city of St. Louis, Mo., commenced work on altering the course of the River Des Peres and to this day the work is still going forward. When the task is completed a 13 mile stretch of the river will flow through a horseshoe tunnel 32 feet wide and 29 feet high.

The estimated cost of the project will be about $11,000,000, averaging about $850,000 to the mile.

Element No. 91

Protactinium (chemical symbol Et or Pa) with an undetermined molecular weight has finally been isolated after research by Aristid V. Grosse, Director of the Chemical Research Institute, Shanghai, China. No. 91 is not a newcomer in the periodic table, however, since this extremely radioactive element was first predicted more than sixty years ago by the great Russian scientist, D. I. Mendelieff, when he was compiling the periodic table of elements.

Comparable properties have been discovered in protactinium and in radium. No. 91 evolves alpha, beta, and gamma rays to a much greater extent than does radium. Other very valuable facts which were determined during the exacting experimental work show that the average life of protactinium is 40,000 years as compared with 2,500 years for radium. Significant in the isolation of this element is the fact that the pure product may be procured from the by-products of radium. Chemists have indulged in the problem of extracting the very valuable element from the uranium wastes, which already have yielded radium. Since protactinium is twice as rare as radium we naturally conclude that the cost of isolation would be prohibitive, since at the present time the cost of one gram of radium is $65,000; but extensive wastes from radium factories offer an expedient for cheap production.

Belgium and the United States are the only two countries where sufficient raw materials have been found to produce No. 91 on a large scale. Figures show that radium waste in the United States has one hundred grams of protactinium stored in it, a large quantity when we consider that the world's radium supply since its beginning has been a mere three hundred and fifty grams. Protactinium can be extracted in a proportion of one part to ten million, when the finest samples of uranium ore are used.

It is thought that the element may help revolutionize the theory of radioactivity, not because it is so essentially different from other radioactive elements, but because enough of the rare substance may be isolated to allow

Engine house, shop and power plant, Great Northern Railway, Seattle.

determined research into the mysterious properties involved. This extremely heavy element is unusual for it is the only radioactive element known which is a metal, and consequently we can assume that the field of metallurgy may be enlightened.

World's Largest Transformers

The largest transformers in the world have been built for use by the Pennsylvania Power & Light Company for the transfer of energy at their plant located at Bushkill, Pa. Four of these huge transformers were built. Each transformer is 35 feet high and covers a floor area of 22 by 23 feet. Each transformer weighs approximately 300 tons and requires more than three tank cars of oil or 32,000 gallons.

The transformers are rated at 220,000 kv., but were tested at 570,000 kv., which is the highest voltage that has ever been applied to a power transformer. The core of each transformer consists of sixty-three tons of laminations. The coils contain fifteen tons of copper, which give windings that are about 32 miles in length.

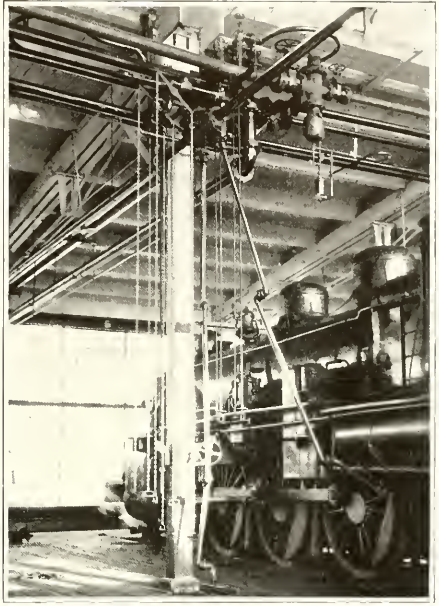
To move the transformers in the course of shipment required the services of a number of men almost equal to the number required to move and load a large circus. Fifty-six freight cars were necessary to transport the transformers and parts to their destination. The weight of each transformer as prepared for shipment was 270,000 pounds. It was necessary to use a special type of depressed car equipment to permit clearance under vehicular and cross line bridges. At the bridge at Caldwell, N. J., the tracks were temporarily lowered 18 inches to permit clearance.

Each transformer was packed in a specially designed shipping tank. In order to meet the shipping demands of the Erie Railroad, the oil was drained from the transformers and the shipping tanks were filled with dry nitrogen gas to preserve the insulating properties of the coils during transit.

Largest Underwater Tunnel in England

Plans for improving communication between Liverpool and Birkenhead, England, under consideration for many years will now be realized following Parliament's approval of the plan of constructing a tunnel under the Mersey River. The tunnel will have a total length of 2.16 miles and will have an interior diameter of 46 feet 3 inches. It will accommodate four lines of vehicles and possibly a street car line. No definite decision, however, has been reached on the matter of alloting space for the car line.

In April, 1928, the work of laying a preliminary tunnel along the line of the future main tunnel was completed. The purpose of laying the tunnel was to enable the engineers to explore the ground and determine the relative amount of labor that would have to be involved in the construction work. Since the results proved very favorable initial steps have been taken toward the construction of the main tunnel.



Typical double direct steaming section in Great Northern engine house.

Oil Power

Diesel engines, the byword in scores of modern engineering projects, have been triumphant again in industry by their adaption to railroading. The Canadian National Railways have built a new type of oil consuming "iron horse" known as No. 9000.

Crude oil, considered as the lowest form of quick, combustion fuel, is being used as the fuel in propelling the compact Diesels with their dynamo attachments, which develop in excess of 1500 horsepower. No. 9000 has two units of 1500 horsepower that supply sufficient power to drive a complete train under the most adverse conditions. A transcontinental test run was conducted to discover the faulty and commendable features of the new locomotive. Not only did the locomotive take the rolling stock on a record smashing journey from Montreal to Vancouver in 67 hours, but a profit very seldom made in railroading was earned. On the entire trip five drums of crude oil were consumed; this point deserves consideration when it is known that crude petroleum costs but a few cents a gallon.

More power and less tonnage has been the secret of this remarkable invention. Diesels require no auxiliaries which are so potent in the steam engine. A minimum amount of petrol is necessary to keep the pistons pumping, but present day locomotive motor supplies have always been available. It seems evident that a revolution is on the horizon since the history-making trip of this new locomotive.

Steam trains have never been able to maintain a rate of speed in excess of 30 miles per hour while traveling a mountain country. In comparison, the No. 9000 attained a speed of 60 miles per hour with no visible effects on the driving mechanism.

With oil as fuel, the smoke nuisance is abolished. The unburned carbon expelled from steam locomotive flues always had a bad effect on health. It is hoped that the record set by No. 9000 will encourage the production of more engines of this type.

Wood Tunnel

Wood as a lining for tunnels is creating an engineering precedent in the two mile shield-driven tunnel which is being built to supply water from the River Rouge to the new Ford plant at Detroit. At the bottom of a seventy foot shaft a huge steel shield 19 feet in diameter will be forced horizontally through the earth by twenty hydraulic jacks. As the shield is pushed along the tunnel, longleaf yellow pine timbers, four feet long and eight inches square, are lined behind it. These timbers are beveled and fitted around the periphery of the tunnel so that they are held in place by the pressure of the surrounding earth. The use of wood for this purpose is new. Cast-iron has been the conventional material for this purpose. Tests made on the timber have shown that the timber more than meets the demands

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Make The Armour Engineer the best technical college publication in the country.

> *As you think, you travel; and as you love, you attract. You are today where your thoughts take you. You can not escape the result of your thoughts, but you can endure and learn, be it base or beautiful, or a mixture of both, for you will always gravitate towards that which you, secretly, most love. In your hands will be placed the exact results of your thoughts; you will receive that which you earn; no more, no less. Whatever your present environment may be, you will fall, remain, or rise with your thoughts; your wisdom, your ideal. You will become as small as your controlling desire; as great as your dominant aspiration.*
>
> —*James Allan.*

"MACHINE MYTH." The "Machine Myth" is an idea, originating years ago, that the effect of labor saving machinery is to reduce employment and to reduce wages. A myth, as we know, is an assumption that is accepted because it is easy to believe, and is not based on fact and reasoning power. The "Machine Myth" is typical.

The glory and the culture of Greece, and other ancient nations were a result of the adoption of slavery. Without slavery there would have been no science, no philosophy, no art, no literature, no leisure, and no comfort. Today machines are our slaves, without which we too could not enjoy the benefits of civilization. "Man," Carlyle says, "Is a tool using animal."

There have been three periods in the history of modern civilization in which we have forged ahead with exceptional rapidity. The first was the Industrial Revolution, following the introduction of the steam engine, when machines started to become used industrially. The next period followed the perfection of the alternating current system, for power use during the last century. It marked the beginning of the use of electric power, with new possibilities and new conveniences. The final period, just after the war, was the installation of automatically controlled apparatus. Machines took the place of men, doing all sorts of jobs better and more accurately.

It has been, and is, believed by many that the result is unemployment, over production, and a tendency to change man from a distinct individual to a mechanical robot. None of these things are true. There probably was a time during which they were more nearly so, but now conditions have changed. A man is not permanently located in one spot and fit to do only one kind of work. Today, the effect of increased production is to raise the wages of the worker. This, with the lower cost of goods, increases his buying power; his standard of living is raised, and his demands increase. As his demands increase, production increases, more men are hired, and the result is the so-called "benevolent circle," in which conditions improve steadily. As the desires of labor seem insatiable, prosperity continues. The automobile industry illustrates this very nicely. Machinery made possible cheap cars; cheap cars meant an increased demand by the middle class, increased production reduced prices still further, which in turn increased the demand. All the while the number of men employed was steadily growing. It was just this sort of thing that has made the American laborer what he is today.

NEW QUARTERS have been assigned to the *Armour Engineer.* The new office is located on the first floor, Chapin Hall, the third door south, directly across from the new rooms of the Campus Club. Instead of the small single room that we formerly occupied, the new office has a large room with a direct view of the street and a small room for storage of cuts and the files. We are very much satisfied with the larger and lighter rooms and are sure the more cheerful atmosphere will help us to work more efficiently.

ENGINEERS AND ENGLISH. English is not a popular course in a technical school. It is looked upon by some students as a nuisance and a bother, which should not be tolerated. As a result of this feeling, these students do not attempt to make any effort to obtain anything out of this course. In their ignorance they look down upon a thing which should be their greatest asset. They fail to recognize that a thorough training in English, grammar, or self-expression is a very necessary thing for success after graduation.

A large concern needs men in technical branches. It gives notice to an engineering institute that it will interview men for the purpose of obtaining a number for certain positions. The Institute sends men in answer, as a result. Now, put yourself in the position of the person who is interviewing these men. An engineering graduate walks into your office. The records show that he is one of the highest in the class. A glance shows that he is neatly dressed and has a good appearance. However, when he starts to answer your questions you are in doubt. He is ill at ease. He stutters, pausing for long intervals in search of the words that will not come. His vocabulary is very limited. In short, he does not talk like a college graduate. You ask him technical questions. He knows the answers but he again stutters in search of words. The whole thing is that he cannot express himself. He does not impress you as you think a college graduate should.

On the other hand, suppose another young man walked into your office. He also is ill at ease but he answers your questions in a clear, distinct tone of voice, choosing his words carefully. His enunciation of the English language makes you think of your English teacher back in high school. His words flow from his mouth in a cool, voluble manner. He just sounds good. He knows how to express himself. He has plenty of confidence.

Now ask yourself this question: Which man would you hire? Which man would you want to represent your idea of a college graduate?

THE FRONTISPIECE is an architect's drawing of the new John G. Shedd Aquarium in Grant Park. This magnificent marble structure, when completed, will be the largest fisheries exhibition in the world with a stock of 8,000 fish of all descriptions. The building is located on the lake shore, near the Field Museum and opposite the Adler Planitarium. Its erection was made possible by a three million dollar gift of John G. Shedd, chairman of the board of directors of Marshall Field & Co. The building was opened for inspection last month and it is expected that the fish exhibition will be complete by May. In the center of the rotunda is a pool arranged to represent a swamp, waterfalls and two small lakes.

THE COVER shows one of the two sister ships, ZRS-4 and ZRS-5 now in the process of construction, as it will look flying over the nation's capital. The Graf Zeppelin demonstrated that practicability of this type of ships for long distance travel. These new ships, almost double the size of the Graf, bring one to wonder when the limit in size will be reached. Greater size means greater carrying capacity and an increased cruising radius. When the advantages due to increased size are balanced by the disadvantages of increased bulk, cost, maneouverability, and storage facility problems, then and only then will the size remain fixed.

THE NINETY AND NINE

We hear about the clever man,
The man who leads the line,
But seldom do we hear about
The other ninety-nine;
The men who bravely battle in
A world of enterprise,
Who form the stepping stones on which
The clever man may rise.

The wheel of life is not of cast
That issues from the mould,
On each small part depends the heart
Which hath the greater hold;
The outer pinions may revolve
And glisten in the sun,
But it's the oil-stained cogs beneath
On which those pinions run.

Cooperation is the word
That's worthy of a thought,
By that alone can all men gain
The brotherhood long sought;
Each man has got his part to play,
Each man can hope to shine,
But he who leads must surely needs
The other ninety-nine.

—*Author Unknown.*

TIME. Where time began and when time will end nobody knows. Time has been defined by Karl Pearson in the following manner: "Of time as of space we cannot assert a real existence; it is not in things, but is our mode of perceiving them." Time is purely a relative thing and yet if we come to a realization of what it really is we have one of the most valuable things in life.

In this modern age it is getting things accomplished in the smallest number of minutes possible that counts. Everything is done along as speedy a plan as possible. Airplanes, automobiles, ships—all kinds of vehicles and transportation—are made so as to cover a great deal of space in a very short time. Thus one can see that time conception plays an important part in one's life.

As engineering students we have a certain amount of work to be done in a limited number of hours. To waste this time is foolhardy, to grieve over it is unwise. If we plan our study with time conception in mind we can surely accomplish a lot more in a smaller number of hours. When we come to school we are told that to learn how to study is one of the most important things in a student's career. Surely how to use our time is just as important. A study schedule planned with this idea in view surely would better a student and save him a lot of grief. Meditating study causes more worry than getting down to business and it is a waste of precious time. Ask yourself this question, "Have I a proper conception of the value of time?"

HONORARIES. Our freshman may perhaps have seen the various keys displayed on the watch chains of upperclassmen and wondered what they represented. Others have heard vague talk of honorary fraternities but do not understand their aims, purposes, and the elegibility of prospective candidates.

There are nine honorary societies at Armour: Tau Beta Pi, engineering; Pi Tau Sigma, mechanical engineering; Eta Kappa Nu, electrical engineering; Phi Lambda Upsilon, chemical engineering; Chi Epsilon, civil engineering; Salamander, fire protection engineering; Scarab, architectural; Sphinx, literary; and Pi Nu Epsilon, musical.

Their purpose is to provide an incentive for the attainment of a high standard of scholarship and also to reward those who have attained this high standard. However, membership is not decided on scholarship alone. Scholarship only makes the man eligible for membership, and in addition he must have displayed marked leadership, initiative and character. Social good-fellowship, activities, and attitude toward the work all help in the selections. Most of the societies take in men in their junior or senior year that are in the upper quarter of their class scholastically. It is well worth the while of the freshmen and sophomores to keep these societies in mind and to work with this goal ahead.

JOHN NAPIER, the inventor of logarithms, was born at Merchiston, near Edinburgh, in 1550 about the time that the Reformation of Scotland was beginning. In 1563 he matriculated at St. Salvatore's College, St. Andrews.

Early in his college life Napier showed a marked aptitude toward religion, and became a champion in the cause of Protestantism. He was appointed a member of various committees dealing with church problems and about the year 1595 he published the book Plaine Discovery. This may be called the first interpretation of the theological work in Scotland, for it is quite without a predecessor in its own field. Of course Napier lived during the time when religious factions fought fiercely for their viewpoints and his works may bear a partial preference for his own sect.

After the publication of Plaine Discovery Napier seems to have had a change of heart. Various documents, bearing his signature, tell of the many implements of war he designed. Some were tried out and according to Sir Thomas Urquhart a piece of artillery made by Napier was fired upon a plain in Scotland with great success.

Little is heard of Napier till 1614 when he introduced his book of logarithms which consisted of fifty-seven pages of explanatory matter and ninety pages of tables. In 1617 he published the Rabdologia a duodecimo of one hundred fifty-four pages. In this book he describes three methods of multiplying and dividing.

Napier died April 14, 1617. In the period of sixty-seven years he had written the first theological treatise in Scotland, designed implements of war, and lastly gave to the scientific world the method for working laborious problems and computations with ease and rapidness.

The treatise of logarithms by Napier can be placed in the history of British science as second to that of Newton's Principia. Truly, a brilliant man.

COLLEGE NOTES

Tau Beta Pi

The chapter of Tau Beta Pi at Armour will have its informal initiation on Jan. 14, 1930. The following men will undergo the rituals at that time: G. W. Baker, '30; N. D. Buehling, '30; E. Blomme, '30; W. Trognitz, '30; E. W. Mullins, '30; W. N. Alderman, '30; F. B. Attwood, '31; C. F. Vojtech, '30, and C. T. Link, Jr., '31. They will be formally intiated into membership Jan 22, 1930.

Pi Tau Sigma

The first of the major activities of Armour Delta was a pledging smoker held on Oct. 28, at which were pledged J. E. Higgins, V. E. Nelson, H. H. Stebbins, and M. H. Van Der Velde, seniors, and C. T. Link and F. F. Strassenburg, juniors. Following the usual period of preparation on the part of the pledges, an invitation ceremony was held Dec. 13th which included a banquet at Coffee Dan's.

At the national convention of the nine chapters of Pi Tau Sigma held this year at Cincinnati, Armour Delta was represented by H. Faulstich. Several very important measures were passed which will aid greatly in bringing the various chapters and alumni into closer bonds of fellowship.

The officers for this semester are:
E. R. Rowley, president.
C. G. Anderson, vice president.
H. W. Faulstick, treasurer.
R. M. Spencer, recording secretary.
C. F. Vojtech, corresponding secretary.

Salamander

The honorary fire protection engineering society at Armour had their semi-annual initiation smoker on the evening of December 18, 1929, at which time the following men were admitted to membership: C. H. Jones, '30; J. Lossman, '30; A. C. Haegle, '30; N. C. Narten, '30, and A. F. Wilde, '31. The members took this occasion to bestow honorary membership upon Mr. Fitzgerald of the Underwriters Laboratories. He was the head of the Fire Protection Engineering department at the time it was introduced into Armour and was instrumental in organizing the course.

Chi Epsilon

The Armour chapter of Chi Epsilon, the honorary civil engineering fraternity, has carried on its work through the medium of regular weekly meetings held on Wednesday afternoons at 3:30. Pledges and members attend and carry on the work of promoting fellowship among the members and stimulating an interest in their chosen profession.

The following men are pledged this semester: G. W. Kohout, M. O. Nelson, and R. A. West. Plans are being made for the semi-annual initiation banquet and theater party to be held in the near future. Alumni and faculty members are expected to attend.

OUR VARSITY CAPTAINS

Track

Donald J. Paul, '30

Our track team this year will be under the leadership of Don Paul, a senior student in the Department of Fire Protection Engineering. He was born in Chicago on September 16, 1906. His prep school training was completed at Lane Technical High School, where he was active in athletics, playing tackle on Lane Tech's championship team. He was All-City tackle that year. Paul entered the University of Illinois for a year, after which he came to Armour.

Ever since coming to Armour he has been active on the track team, winning his major "A" in his freshman year. His specialty is the shot-put, and his ability in this event has won for him the Bartlett Gym Record at the University of Chicago. He also placed fifth in the National Intercollegiate meet last June, throwing the shot a distance of 47.5 feet. Don also offers strong competition in discus throwing and in the high jump. With his ability in winning points and his aid in organizing a winning team, Armour can look forward to a very successful track season.

Donald J. Paul

Paul has also been prominent in other school activities. He was elected President of the freshmen class and while a sophomore indicated his ability for leadership when he led his class to victory in the Sophomore-Freshman Class Rush. Don also served on the Sophomore Social Committee and as a Junior Marshall. He is a member of the Honor "A" Society and the F. P. E. S.

Eta Kappa Nu

Eta Kappa Nu, honorary electrical engineering fraternity, held their informal initiation in their rooms in Chapin Hall on December 1. The pledges were put through a strenuous evening.

The formal initiation was held before a group of alumni members from the Chicago Chapter on December 18. The initiation took place at the Engineers' Club and followed a buffet luncheon. The men initiated were Walter L. Filmer, Edwin W. F. Hanke, Carlton E. Rudelius, and Herbert E. Stier, seniors, and William Drigot and Rudolph Patzelt, juniors. Alumni members of Eta Kappa Nu, from various concerns, gave talks for the benefit of Delta Chapter on employment after graduation.

A theatre party is being planned in the near future and many alumni members are expected to be present.

Phi Lambda Upsilon

Phi Lambda Upsilon held its informal initiation in its rooms on Wednesday afternoon, January 15, at which time the following men received their keys:

Fred B. Attwood, '31.
Isadore Drell, '31.
Homer Z. Martin, '31.

The initiation banquet held jointly with Flask and Beaker, professional chemical club, followed that evening at the Union League Club.

Pi Nu Epsilon

Pi Nu Epsilon, the youngest honorary fraternity at Armour is now three years of age. The members of the organization are proud of the record established by the fraternity in this short time.

Many interesting meetings have been held during the past semester with Brother Frank Aste acting as president. One of the features of the year was the announcement of a contest which was open to all students of the Institute.

The men considered eligible for membership in Pi Nu Epsilon were guests at a smoker given at the Delta Tau Delta house on the evening of December 4. After the men had proved their fitness to the satisfaction of the actives, they were given the scarlet and gray ribbons.

R. Eddy, J. Kovarik, F. O'Conor, W. Schrader, and R. Wilson are now going through their pledge period.

A. I. E. E.

The Armour branch of the A. I. E. E. attended the District Meeting, which was held under the auspices of the Great Lakes District, with its headquarters at the Drake Hotel, December 2 to 4.

Among the points of interest which were attended during this convention were: Crawford Ave. Generating Station, the new Chicago Civic Opera, the Illinois Steel Mills, the Western Electric factory, and the Longbeach automatic telephone exchange.

At the student's session, a paper was presented by Clement J. McDonald, '29, on "Electrical Equipment Aboard Modern Steam Liners."

Friday, December 6, 1929, Mr. P. F. Wareing, engineer in charge of the transmission experimental laboratories of the Universal Wireless Communication Company, spoke to the Armour Branch on "Some Engineering Problems of the Universal Wireless."

A. S. M. E.

The student branch of the American Society of Mechanical Engineers held its first meeting October 25. President Stebbins opened the meeting by explaining the purpose of the society and the value it would be to a student in acquiring a good perspective on enginering problems. At this meeting Professor Roesch was elected honorary chairman.

The branch has had a very good start in its activities this year. In addition to having outside men talk from time to time, some time has been devoted to enable the members to become accustomed to speaking before an audience. Mr. R. M. Spencer, chairman of the program committee, distributed mimeographed blanks which when signed, pledged the members to give a talk on a specified topic at some future meeting. The results and benefits of this system are evident, judging from the interesting talks which have been given by some of our members.

The first smoker of the year was held on December 11 at the Theta Xi house, and more are expected to follow.

Armour Tech Campus Club

Just before the Christmas holidays the Campus Club was besieged by persons with hammers, saws, and other instruments of the carpenter's art who completely demolished our former quarters. But now, phoenix-like, new rooms have been decorated and we are again quite comfortable.

The Campus Club wishes to thank the Dean's office for their thoughtfulness in arranging our transfer.

Preparations are being made for our annual banquet tentatively scheduled just after the exams at the Great Northern hotel. Installation of officers will be held at the banquet. Elections will be held the third week in January.

The retiring officers are:

Executive Secretary, H. H. Stebbins.
President, M. Zwart.
Vice-President, L. Statkus.
Social Secretary, A. Frost.

In closing the Campus Club imparts to the rest of the school our best wishes for a prosperous New Year.

Armour Tech Rifle Club

The members are enthusiastically practicing during their spare time at the range. The match with St. John's College rifle team from Brooklyn, N. Y., was the first of the season. The match was fired in prone and standing positions; the five highest point men being counted in the scoring. Although the Armour riflers had a lead of 56 points in the standing position, the St. John's team showed their superior marksmanship in prone firing when they finished 119 points ahead. The final score stood 862 to 799 in favor of St. John's College.

The club is the proud possessor of two new rifles. This will enable more members to practice without having to wait for their turn to use the club's rifles.

Phi Kappa Sigma

Various and interesting events, happening during the past three months have kept things moving for the men at the Phi Kap house. Starting the season with an inaugural dance in honor of its rushees, the chapter found pledging, its annual Founders' Day Banquet, Parents' Day, Alumni Smoker, and the Mid-semester dance well upon its heels scarcely before the smoke of battle had cleared. The Rushee dance went over successfully, and the banquet, in commemoration of the founding of the fraternity on October 19, 1850, was attended by the active members and alumni of the Northwestern, Chicago, and Armour chapters.

On November 23, a house warming dance was given which was open to the friends of the chapter at the Institute. Together with the record attendance of visitors and the regular turnout of its members the chapter was obliged to use its new home to its utmost extent. The best efforts of every man in the house were directed toward making the affair a success. Music of just the right quality, as rendered by Coffee Dan's Orchestra, and several oriental dances interpreted by a professional made success a sure thing.

The Biennial Alumni Smoker, attended in full force by both actives and alumni, turned out to be a gathering of new and old friends. A grand time was enjoyed by all.

Delta Tau Delta

December 31, 1929, saw the house transformed! Anyone with superstitution of any kind would not have dared to come across the door step, for the decorations were well chosen and placed for an appropriate "Friday 13th Dance." Bats, black cats, and other wierd objects formed the background. The music was hot and supplied the finishing touch to one of the best pledge dances held at the house.

James M. McAlear '31 spent a week with us at Thanksgiving time and is looking much better after a long illness.

Paul Malm '31 is also improving after his operation and has been around for a few visits.

Gamma Beta of Delta Tau Delta wishes to extend to the faculty and the student body of Armour its best wishes for a Happy New Year.

Theta Xi

An informal Hallowe'en party and dance was held on October 26. The House was decorated for the occasion and a large congenial crowd attended. The next affair was a Sunday afternoon dinner dance held on December 15. Twenty-eight couples were present to make this one of the biggest affairs of the season.

The first initiation of the school year was held on the 7th of December. The five new men who wear the T.X. badge are: F. LeGrady, M. Lukey, R. Long, O. Murphy, and J. Taylor.

With the coming of the second semester, Theta Xi expects quite a few former members back at school. Among those who have been out for one or more semesters and are returning are: Leroy Booker and Harry Smethells.

The remaining list of pledges now includes the following names: G. Belton, W. D. Jackson, W. Tyler, C. Cleland, C. Marsh, R. Ellis, J. Pecham, J. Sorensen, T. Leavitt, R. Mulroney, R. Carlstrom and C. Nelson.

Sigma Kappa Delta

On December 21, 1929, Sigma Kappa Delta was host to a large group of alumni, actives, and pledges at the chapter house. The occasion was the annual Christmas dance. Under the competent guidance of Brother Roffee the affair was run in a brilliant manner much to the satisfaction of those present.

Brother Horras who was ill with an attack of appendicitis during the holidays has fully recovered and is in school again.

Sigma Kappa Delta takes pleasure in announcing the pledging of F. L. Strassenburg '31 and R. M. Krause '31.

Beta Psi

Beta Chapter wishes to announce that Frank E. Rutkowski C. E. '31 has been duly initiated and is now a full fledged active. The Inter Chapter Dance sponsored by Beta and held at the St. Claire Hotel, November 30, 1929, was a huge success. The members and alumni of the Illinois, Lake Forest, and Armour chapters agreed with their lady friends that the dance was a fitting way to celebrate the Thanksgiving Holidays.

Although the elements were allied against mankind, the Christmas party held Friday, December 20, 1929, was attended by a large number who danced to radio music amid appropriate Christmas decorations.

Triangle

A glance over the period elapsed since the last issue of the *Engineer* brings forth many events of interest enjoyed by the members of Triangle. One which every man who was there will long remember was the pilgrimage to Champaign the last of November. The Fireman's Ball turned out to be a great success.

The annual snowball was held as usual on the last Saturday before Christmas, the scene being shifted from the chapter house to the Blackhawk Restaurant, truly a fitting beginning for the holiday season.

With the approach of the new semester, we are hopefully looking forward to welcoming about eight new members into the chapter.

Kappa Delta Tau

Kappa Delta Tau announces the pledging of J. Seigal and F. Altschuler.

The annual pledge banquet was held December 13. The banquet was followed by a theatre party. The whole chapter was present, including many of the alumni.

A dinner dance was held New Year's eve at the Sherman Hotel. A large attendance and much "whoopee" was the result.

The chapter is planning a "between semester" party as a remedy for the mental exhaustion which shall result from the final examinations. No doubt the cure will prove effective. The chapter is planning a record year of activities for this new year of 1930.

Rho Delta Rho

The year 1929 has been one of unprecedented growth in the field of fraternal activities for Rho Delta Rho.

A social program of unusual style and variety was carried through with remarkable success, and the active chapter hopes to make the new year as brilliant as the one just past.

INTRODUCTION

"Remember when we first met in the revolving door at the post office?"

"That wasn't the first time we met."

"Well, that's when we began going around together."

"Do you know that girl?"

"Oh, just a nodding acquaintance."

"What do you mean, nodding?"

"Nodding doing."

College Boy: "Do you pet?"

The Girl: "Sure—animals."

C. B.: "Go ahead then; I'll be the goat."

DAYS GONE BY

Do you remember way back when,
(Say thirty, forty years)
You never saw your sweetheart's limbs,
But judged her by her ears?

The kids were washed each Saturday night,
Their daddy cut their hair,
Their suits were made from Uncle's pants,
And they wore no underwear.

The women padded but did not paint,
Nor smoke, nor drink, nor vote,
The men wore boots and little stiff hats,
And whiskers like a goat.

Not a soul had appendicitis,
Nor thought of buying glands,
The butcher gave his liver away,
But charged you for his hands.

You never needed a bank account,
Your beer gave six percent,
The hired girls got three bucks a week
And twelve bones paid the rent.

IT'S ALL THE SAME TO HIM

Passerby: "Dear me, my good man, did you fall down the steps?"

Inebriate: "Yes, but it's all right, I was going down anyway."

BUTTON—BUTTON

Mary Lou: "Is you husband still the loud dresser he was before you married him?"

Estelle: "I should say so, you should hear him when he is looking for his collar button."

AW!

She: "Did I ever show you the place where I hurt my hip?"

He: "No, no."

She: "All right, we'll drive over there."

A woman can't make a fool out of a man unless she has cooperation.

Elderly Man: "Well little girl, and what are you going to do when you grow up to be a big woman like your mother?"

Modern Child: "Diet, of course."

TO THE POINT

It's the little things in life that hurt. You can sit on a mountain but not on a tack.

Jinks: "I've bought the little lady a machine of her own."

Binks: "Packard, Lincoln, Marmon, or Buick?"

Jinks: "Maytag."

"Why are your socks turned inside out?"

"Oh, my feet were hot so I turned the hose on them."

The child's version:

Twinkle, Twinkle, little star,
How I wonder what you are
Up above the world so high
Like a diamond in the sky.

The engineer's version:

Scintillate, Scintillate, diminutive constellation,
Interrogatively and inquiring I question your constituent elements,
Situated at such a prodigious altitude above the celestial sphere,
Similar to a carbonaceous, ismatic suspended in the heavenly firmament.

—R. L.

A fair young girlish Russian
Was loved by a strong-armed Prussian.
From the sofa one night
Came a scream of delight,
The Russian, the Prussian, was Crussian.

She: "What do you mean by kissing me? I say what do you mean!"

He: "Why—er—nothing."

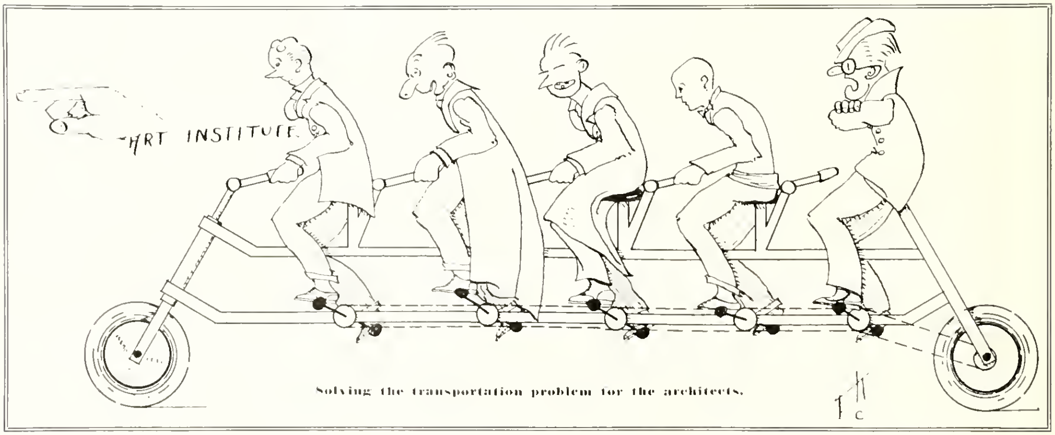
She: "Don't do it again. I won't have any man kissing me unless he means business. Do you hear?"

"Mother," asked little Benny, when they had guests for dinner, "Will the dessert hurt me or is there enough to go around?"

Many single men long for the peace and quiet of married life—so do two thirds of the married men.

She: "Do you believe in trial marriage?"

He: "I surely do—any marriage is a trial."



Solving the transportation problem for the architects.

THE ARMOUR ALUMNUS

J. Warren McCaffrey, '22, Editor

Armour Alumnus Now Printed in Armour Engineer

Warren McCaffrey Devoting Only Part Time to Alumni Work

Since December 1, 1929, the duties of Manager of Industrial Relations and Executive Secretary of the Alumni Association, have been performed by Warren McCaffrey, '22, on a part-time basis. The new arrangement will continue as long as it proves practicable.

The headquarters of the Alumni Association will continue to be at Armour Institute of Technology, 3300 Federal Street. Although Mr. McCaffrey will not always be there, telephone messages left for him at Victory 4600 will be promptly attended to, and all mail should be sent to this address.

For personal interviews, Mr. McCaffrey can be more conveniently seen at 22 West Monroe Street, Room 1600, and he suggests that all callers will please telephone Franklin 6063 in order to be sure he will be in the office when they arrive.

Alumni Officers for 1929-30

Trustees

Roy M. Henderson, '02
Robert B. Harper, '05
John J. Schommer, '12

Officers

John J. Schommer, '12, President.
James C. Matchett, '07, Vice President.
Louis Hirsh, '14, Secretary-Treasurer.
Warren McCaffrey, '22, Executive Secretary.

Board of Managers

Ralph H. Rice, '97
Henry L. Nachman, '02
Harold C. Davies, '07
Claude A. Knuepfer, '15
S. D. Nothhelfer, '18
Edward A. Goodnow, '22

Armour Represented at Conference of Major Industries

Prof. B. B. Freud, Prof. H. McCormack, George S. Allison, and J. Warren McCaffrey represented Armour Institute at the Sixth Conference of Major Industries held at Mandel Hall, University of Chicago, October 23. The conference, conducted in the interests of education and industry, is held every year under the auspices of the University of Chicago and the Institute of American Meat Packers. Some of the Armour alumni present were Charles T. Walters '21 now in the Superintendent's Office, Swift & Co., and Richard W. Regensburger '20 also with Swift & Co.

Axel Hofgren, '18, was married during the summer. He was last seen on December 2, 1929, in the custody of his wife while attending the Christmas Concert of the Swedish Choral Club at Orchestra Hall.

Alumni Decide to Discontinue Separate Publication

At the meeting of the Board of Managers and Officers of the Alumni Association held in conjunction with the luncheon at the Chicago Engineers' Club on December 3, the following resolution was voted and passed upon:

"Whereas the Constitution of the Alumni Association of Armour Institute of Technology requires that any changes or amendments to it be regularly made in the form of a resolution passed upon favorably by a majority of the Board of Managers and Officers of the Association, and

"Whereas, it has been thought expedient to discontinue the distribution of the *Armour Alumnus* as a separate publication, and

"Whereas, the *Armour Alumnus* can be incorporated as a unit in the *Armour Engineer*, there being an invitation of record to do so,

"Therefore, Be It Resolved, That the amendment to Article VII, Sections 1 and 2, providing for the publication of the *Armour Alumnus* as the official alumni organ and its distribution as a separate publication, be amended as to the latter part, and further,

"Be It Resolved, that the *Armour Alumnus* be incorporated henceforth as a distinct unit in each issue of the *Armour Engineer*, and further,

"Be It Resolved, that copies of the *Armour Engineer* be distributed without cost to all Life Members of the Alumni Association and to all those Alumni who pay $3.00 dues each year and to all those Alumni from the last graduating class who pay 50 cents in addition to $1.00 dues which they pay the first year after leaving college."

The November issue of the *Armour Engineer* has been sent to all those entitled under the above conditions to receive it except those Alumni who paid their dues after the available supply of copies had been used. They will not get that issue but will receive the remaining issues because we have nearly doubled our order for copies of the three remaining issues. We regret that our first order was not large enough to care for the demand for copies that followed Louis Hirsch's letter for dues and trust those who did not receive the first number will overlook that fact. For our part we will endeavor to make the remaining numbers well worth your alumni dues.

The drawings which Mr. Jay Edwin Peterson, '26, submitted in the final competition for the 22nd Paris Prize are now on exhibition in the architectural drafting rooms of the Art Institute.

May Be Only One Alumni Banquet This Term

At the next luncheon of the Alumni Association, which will be Tuesday, February 4, President Schommer will lead the discussion on whether or not the Alumni should continue the custom of having two banquets each year as required by the Constitution of the Association. Should the majority of the members favor only one banquet a year President Schommer no doubt will call a meeting of the Officers and Board of Managers immediately after the luncheon for the purpose of asking them to pass a resolution to amend the Constitution accordingly.

The present practice is to have a midwinter banquet either in January or February and a spring banquet usually in May, which banquet has been the occasion of the annual meeting of the Association. As a rule the banquets held during the winter months were well attended. The spring banquets seemed to be losing favor. There seems to be more of an inclination to attend banquets during the winter or fall months when the weather has broken and we are faced with long evenings indoors.

It is thought that by doing away with one banquet it will be possible to increase the interest and enthusiasm of the Alumni for the other by attempting something extra popular at the time the banquet will be held each year.

To bring about any such change or, to continue the past practice prescribed by the Constitution, it will be necessary that the true and complete sentiment of the Alumni be learned. The officers want a cross sectional view of Alumni opinion on the matter before taking any action. Therefore every alumnus should reserve his luncheon hour on Tuesday, February 4, for this luncheon meeting of his Alumni Association.

Voita Meets Dr. Monin

Severals letters have been received from Eugene Voita, '25, in the last few months. He is traveling around in Europe visiting places of interest and studying its architecture.

From his last temporary resting place—Rome, Italy, he found time to write the last note we received. He enclosed a snapshot of Dean Monin taken upon the steps of the Polytechnic Institute in Zurich, Switzerland. The picture was a remarkable likeness of Dean Monin as we have known him in his last years at Armour Institute.

Friends of E. H. Arnold, '19, will be interested to know that he has moved from 50 Boyden Parkway, Maplewood, N. J., to 1060 Sleepy Hollow Lane, Plainfield, N. J.

Charles Mac L. Moss

Coordinating available men, materials, facilities and the knowledge of the electrical art, in order to control its power in the safest, simplest, and best manner, designing and producing the equipment in the quickest and most economical fashion, and doing this with a minimum of friction so that all parties involved feel and enjoy their mutual responsibility and cooperate closely with each other—such is the work of Charles MacL. Moss, Assistant Manager of the Circuit Breaker Engineering Department of the Westinghouse Electric and Manufacturing Company.

Mr. Moss, a graduate of the Armour Institute of Technology, had the early desires of becoming a lawyer. With that thought in mind, he enrolled in the Chicago University for an A. B. degree. Early in the first year he discovered his mistake and enrolled the following year in the electrical engineering department of the Armour Institute of Technology. There he was elected literary editor of "Fulcrum" and editor of the yearbook. He also was elected senior class president. Graduating with the class of 1902, he received the degree of B. S. in E. E. A few years later he was presented with the degree of E. E.

Upon graduation, Mr. Moss elected to enter the Westinghouse Graduate Student Course, and has been with that company continuously since. During the period from 1904 to 1928 if there was an installation involving more than 2500 kw., he was involved in its design. To him are due the development of several inventions now being manufactured, the best known of which is the "automatic substation."

Mr. Moss is interested in water sports and gathered some local "rep" in Chicago as a yachtsman where he held the "Cock of the Walk" cup of Jackson Park Yacht Club for two seasons, 1900 and 1901. He is a member of the American Institute of Electrical Engineers, the Civic Club, the American Automobile Association, and also various Masonic orders.

Mr. Moss' home address is 612 South Dallas Avenue, Pittsburgh, Pennsylvania.

Monthly Luncheons Resumed

The first monthly luncheon of the Armour Alumni Association for 1929-30 was held Tuesday, November 5, at the Chicago Engineers' Club, 314 Federal Street. There were nearly sixty alumni out to greet their new President of the Alumni Association, John J. Schommer, '12. After a cordial greeting to the Alumni present and a few routine matters of business he launched into his favorite topic, football.

The second luncheon was held the same place on Tuesday, December 3. The guest and speaker on this occasion was Judge Walter B. Steffen, who is coach of Carnegie Tech's famous football team. Although he was unavoidably delayed in arriving for the luncheon he gave a very interesting talk to the large group of alumni present. It was just before the trip his team was to make to the Pacific coast to play football. After he had imparted all the advance information on his plans for that game those present agreed that they would root for Carnegie Tech alongside of their radios at home.

Alumni Association Holds Luncheon

John J. Schommer spoke to the Alumni Association on Nov. 5 at the luncheon held at the Chicago Engineers Club. The subject of the talk was plans for the new year and the interpretation of the new football rules.

Several Armour Graduates With Firestone Company

Graduates from Armour Institute have been actively identified with the Firestone Tire & Rubber Company in recent years. J. C. Harrower, '27, Robert Peacock, '27, and Cyril C. Fraser, '27, were in Liberia, Africa, for a few years doing colonization and rubber plantation work. Walter Hanson, '27, was with them at Akron, Ohio, as was Fraser after he returned from Africa.

Harrower would not accept foreign service again but Peacock has gone to Singapore this time. Fraser probably will remain in the States because he was married this fall. This last bit of information was contained in a newsy letter from John W. Manz, '29.

The Way To Higher Pay

If it should happen that I'm not
Contented with the job I hold—
If I'm unhappy with my lot,
Because I do not draw more gold—
"What am I doing," I should ask.

"To help me win a better task?"
It may be true that I'm not paid
As much, perhaps, as I am worth;
But yet, what effort have I made
To amplify my mental girth?
What could I show the Boss, if he
Some signs of growth, should ask to see?

If he should call me in today,
To let me show why I deserve
A better job at better pay,
What could I show besides my nerve?
To wish for more, is not enough—
We have to show we have the stuff!

But if the wish is strong and hard,
And coupled with the will to do—
I'm apt to get my just reward
And men are glad to pay it, too.
But if I merely whine and sob,
I don't deserve that better job.

So, if I find my job is one,
In which I can but slowly move,
Before one other day is done,
I should do something to improve.
This seems to be the surest way
To earn, and get, the higher pay.

—Chas. S. Kinnison.

Manz, who was captain of the Armour Tech varsity basketball team during the 1928-29 season, joined the Firestone organization after graduation. He is doing a variety of testing work in the power plant and we are reliably informed from the personnel department of that company that they are pleased with him and his work. His friends can write him at 509 Crosby Street, Akron, Ohio.

In his letter "Johnnie" Manz tells about meeting Robert Brown, former captain of the Armour Tech swimming team, in a restaurant of Akron. He is selling for the Anaconda Chemical Company whose products are used in the rubber industry.

Armour Grad Speaks to W. S. E. Members

The Armour Student Branch of the Western Society of Engineers held a meeting at 9:30 December 17, 1929, in Room B, Mission. Mr. Henry R. Matthei, '08, of the Chicago bridge designing division, spoke on "Chicago's Water Supply."

PERSONALS

Met Sereno Streeter, '27, and learned he had changed positions. He is now making architectural drawings for Philip B. Maher, 157 East Erie Street.

The Institute received an unusual Christmas card addressed to all the old friends of the sender at Armour. The scene was of strange men and women walking around in the rain, some under the protection of umbrellas. The card was sent by C. O. Haase, '16, from Tokio, Japan.

Garrett B. James, '11, has left Chicago and located in Youngstown, Ohio, for what looks like a long stay. He is now research engineer for the Automatic Sprinkler Corporation of America.

We have heard a westerner's opinion of Boston from Eugene C. Bacot, '28, before this, but now comes an announcement of his marriage to Marcia Grow Russlow of Randolph, Vermont, on last New Year's day. They will be pleased to hear from friends at home, 65 Dana St., Cambridge, Mass.

Word has been recently received that Frank J. Pischke, '28, who was married on November 23, is now residing at 4025 North Crawford Ave. He and his wife have just returned from a short honeymoon. Frank is now employed in the Long Lines Department of the American Telephone & Telegraph Company.

Sidney S. Pulaski, E. E., '29, visited Chicago a week ago. He is an assistant research engineer in the experimental department of the Time-O-Stat Controls Company, at Elkhart, Indiana.

Robert E. Brumund, '28, is a resident engineer on road construction for the Will County Highway Department. He says the following address, 817 Oneida Street, Joliet, Illinois, will be permanent for at least three more years.

Leroy Bernhard and Harvey Dozois, both of the class of '29 and electrical engineers, according to the latest reports are with the Illinois Bell Telephone Company. The success of the *Armour Engineer* last year was due largely to these two men.

Oscar F. Hedstron '99 is the owner of the Hedstron Pattern Works here in the city.

Louis I. Goldberg, '17, spends his winters at his Chicago home and the other seasons in Michigan making highway improvements. He is president of the Goldberg Construction Company with headquarters at Petoskey, Michigan.

J. Herbert Witte, '25, who has been in the oil burner division of the Underwriter Laboratories, Chicago, took enough time off from work to court and win Mabel Ruth Hipp of Cleveland, Ohio. They were married in Cleveland on October 19. "Herb" went to Cleveland during the holiday season, and brought his bride to Chicago. They are at home now at 4440 North Lincoln Street.

Alumni Fall Before Varsity

Armour Tech opened its 1929-30 basketball season with an impressive 13-17 victory over the Alumni. The game was played on Tuesday, December 10, 1929 at the 8th Regiment Armory at 35th and Giles Avenue.

This contest was a much faster and harder fought game than last year's game which resulted in a varsity victory by only a few points. Although the score was somewhat one sided, due credit is extended the alumni for their fast and accurate passing, a feature of the game.

Otto Kuehn acted as captain of the alumni. Kuehn's accurate passing together with "Vic" Hofer's excellent floor work made the going dangerous for the varsity on a number of occasions. Hofer displayed a good deal of his pre-graduation talent at his right guard position.

Bill Downes made himself conspicuous with his long dribbles through the entire varsity squad. Wittie, Shoemaker, and Kuffel formed a good passing combination which resulted in the addition of 5 points for the graduates.

Coach W. C. Krafft's opening line-up was composed of the following: Captain Simpson, L. F.; Rossing, R. F.; Robin, C.; Rutkowski, R. G., and Bruni, L. G. This quintet appeared to be the most promising combination that could be selected from the group of fifteen that formed the basketball ranks on the opening day.

High scoring honors for the day were garnered by Captain Simpson. His contribution to the varsity cause was two field goals and nine free-throws. Robin, likewise dropped in a good portion of the 37 points, with his two field goals and five free throws. Armour's best scoring attack resulted when Robin tipped to Simpson and in turn Simpson passed to Bruni. Bruni then heaved the ball for the iron rim. A good number of baskets were accounted for in this way, although several apparently easy shots went astray.

The final score 37-17 at the time was not looked upon as indicative of Armour's relative strength on the hardwood, but since then the team has won a number of games evidencing that their good start was an outcome of an improved 1929-1930 team.

Following is the line-up:

Alumni	B.	Ft.	PF.
Downes, R. F.	0	0	2
Wittie, L. F.	2	1	4
Kuehn, L. F.	2	0	3
Shoemaker, C.	1	2	4
Hofer, R. G.	0	0	4
Kuffel, L. G.	2	0	1
	7	3	18

Armour	B.	Ft.	PF.
Simpson, R. F.	2	9	2
Rossing, L. F.	2	0	1
Ott, L. F.	1	0	2
Robin, C.	2	5	3
Tell, C.	0	0	1
Bruni, R. G.	3	0	1
Miran, R. G.	0	1	0
Rutkowski, L. G.	0	2	2
Quinby, L. F.	0	0	0
	10	17	12

The Milwaukee Electric Crane and Hoist Corporation recently opened a branch office in Chicago. Elmer B. Kapke, '28, was selected by them to be the first district manager in charge of this office.

Armour Alumnus Leader in Electrical Industry

A man of good composure, easy presence, and business-like dignity; a man who is easy and willing to be approached on any topic worthy of his time, and yet who apparently has everything systematized to hair-trigger efficiency, and also a man fully cognizant of the great importance of the human factor in business. This is Truman Penfield Gaylord, vice president of the Westinghouse Electric and Manufacturing Company.

Mr. Gaylord is a native of Michigan and was born in Shelby on February 15, 1871. He attended the Allen Academy of Chicago as a preparatory school for his later years in university training, which were devoted to study at the University of Michigan. Mr. Gaylord secured a degree of B. S., and later E. E. from the Armour Institute of Technology.

P. T. Gaylord

The Chicago World's Fair was starting when Mr. Gaylord went to work for the Fair Company as engineer of Underground Construction. This was the first underground electrical work of any consequence done in this country. Following the close of the World's Fair, Mr. Gaylord became assistant professor of electrical engineering at the Armour Institute, Chicago, serving there from 1893 to 1898. He was employed as an engineer by the Chicago Edison Company from 1898 to 1899, organizing their electrical laboratories, and took his first job with the Westinghouse Electric Company in July, 1899. In 1902 he was appointed district manager with offices in Chicago, which position he occupied until he was appointed acting vice president in August, 1914. On April 24, 1929, he was elected vice president.

In 1929 a new department of the Westinghouse Company was created under the direction of Mr. Gaylord. This department brings together under one head all the employes relationships outside those involved in the discharge of their regular duties.

Mr. Gaylord will thus have responsibility and authority for all matters of pensions, insurance, savings, relief, housing, personnel, education, safety and allied subjects with other specific duties already under his charge.

Mr. Gaylord was elected to directorship in the Pittsburgh Chamber of Commerce in 1926 and in 1927 was chosen to be president of that organization, which post he held for two years. He is a member of the American Institute of Electrical Engineers, Chamber of Commerce of the United States, Duquesne Club of Pittsburgh, the Pittsburgh Athletic Club, Keystone Athletic Club, University Club, and Engineers Club of New York.

Architect Grads Place in Plan Competition

Fred E. Sloan, '23, and Elmer A. Johnson, '23, won an Honorable Mention and $100 prize in the recent Lehigh Airports Competition sponsored by the Lehigh Portland Cement Company.

The competition was open to all architects and consisted of drawing the plans for an airport of a modern city.

There were 257 designs submitted and $10,200 in prize money consisting of 1st prize—$5,000; 2nd prize—$2,500; third prize, $1,000; fourth prize, $500; and 12 Honorable Mentions of $100 each.

The December meeting of the American Institute of Architects held at the Art Institute last Tuesday evening was held in honor of the winners of the competition. Professor Wells of the Civil department was present at the meeting.

Messrs. Sloan and Johnson are now practicing architects at 181 East Erie Street.

Aurora-Armour Club Met December 21

The Aurora-Armour Club will hold its banquet and annual election of officers on December 21, 1929, at the Turtle Rock Inn, located six miles south of Aurora. The banquet was planned by a committee consisting of the following men: C. I. Carlson, '19, H. W. Mullins, '30 and Otto Staib, '33.

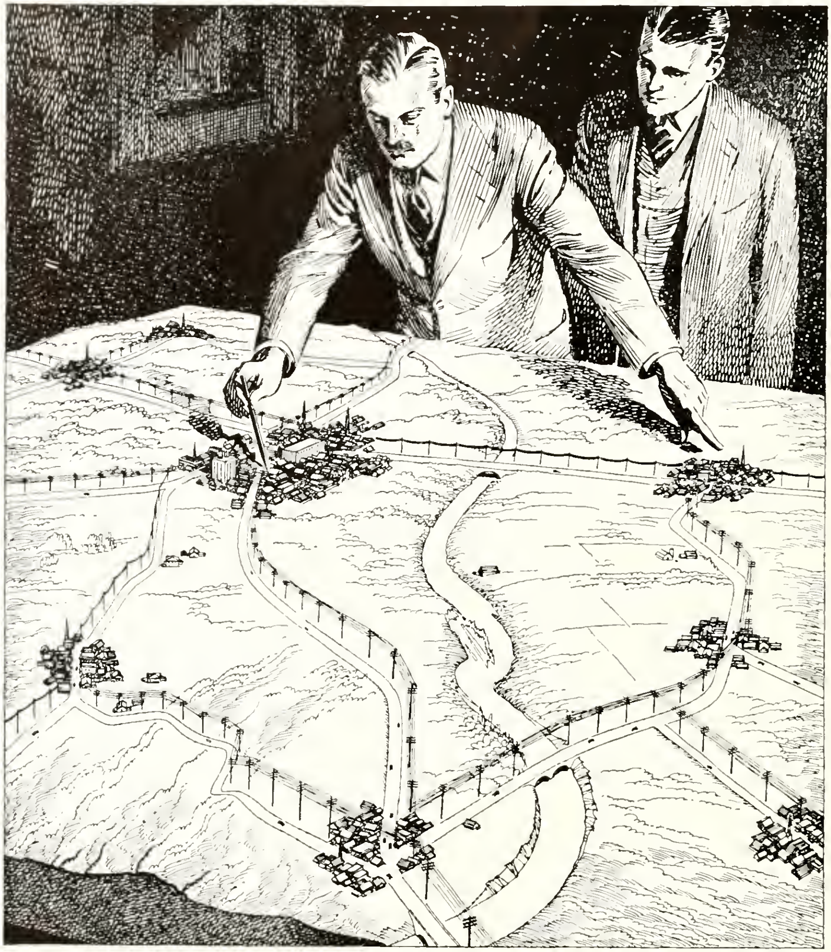
They were fortunate in obtaining Professor Finnegan's consent to deliver an address at that time.

The purpose of the club, which was organized last year, is to present engineering, as a profession to young men, and to offer a means for the students and alumni to get together. The membership of the club now numbers about thirty, all alumni and students living in or near Aurora being eligible.

The present officers of the club are, President, C. I. Carlson, '19; Vice President, H. W. Mullins, '30 and Secretary and Treasurer, R. A. Winsor, '08.

Honor "A" Alumni Banquet

A dinner was held for all alumni "A" men under the auspices of the Honor "A" Society at the Delta Tau Delta fraternity house on Tuesday, December 10. About fifty active and alumni members participated after attending the basketball game at the 8th Regiment Armory. They were entertained by several short talks by different coaches and alumni. Presentation of "A" watch charms was made to the few men who were taken into active membership of the Honor "A" Society. Professor John J. Schommer's address on athletic affairs at Armour, both as to the present and future, and his stories of football, especially of the recent rumpus caused by subsidizing of college athletics, was especially entertaining. After dinner smokes and cards finished out the rest of the evening.



Key Town selling

—a new telephone idea

Commercial development men of the Bell System have originated a new use of the telephone which is proving economical and efficient for modern salesmanship. From important central towns the salesman makes periodic visits to customers and prospects *by telephone.*

To conceive this idea, to make it practical by selecting Key Towns on a basis of most advantageous rates to surrounding points, and to sell it as a business practice—all this illustrates how telephone service is as open as any commodity to constructive imagination.

Key Town selling is one of many indications of the steady demand, present and to come, for more and more telephone service.

* * *

How Western Electric helps to make the idea work . . . . . .

Each year the Bell System calls on Western Electric for more and more equipment. New lines and central offices must be built — old ones modernized and enlarged to take care of new and constantly increasing uses of the telephone.

Raw materials must be gathered from the ends of the earth — fashioned into telephone apparatus and supplies of all kinds — distributed to warehouses throughout the land and held in readiness. When the call comes, shipment and installation must often be made in record-breaking time to make good the ravages of fire or storm. All this is included in Western Electric's dependable service of supply which helps make possible a dependable service of communication.

Backing up the telephone companies of the nation is a big job — and one that never grows dull!

BELL SYSTEM

A nation-wide system of inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

ROASTING OF ORES

(*Continued from page 49*)

The Longmaid-Henderson process for chloridizing copper ores was applied to extract copper from pyritic residues containing from 3% to 8% of copper, and was roasted with salt to convert the copper to chloride and then leached with water or dilute acid and then the copper precipitated with iron. The chloridizing process applied to zinc, lead, and other base metals consists of passing dry chlorine gas under pressure over coarsely pulverized sulphide ore in a closed shaft furnace. The reactions involved are exothermic and supply all the heat required. A temperature of 600 to 700°C. is easily maintained in the furnace by adding chlorine at the proper rate. The sulphur distills off at the top at this temperature and the fused metallic chlorides with gangue in suspension sink to the bottom where they are tapped. The fused chlorides are run into molten lead and the noble metals form lead buttons. From the lead bath the fused chlorides are drawn into another kettle and treated with zinc to recover the lead, the remaining chlorides are then dissolved in water and treated with chlorine gas to oxidize the iron and magnesium. In the final stages of the process zinc chloride solution is evaporated to dryness and the zinc chloride fused and electrolyzed for the recovery of metallic zinc and chlorine gas.

In dealing with roasting apparatus it is mostly a matter of types, referring to the ore and the furnaces and processes.

Heap roasting requires that the ore be in lumps. This type of roasting is practiced mainly in connection with low-grade sulphide-copper, and copper-nickel ores. Ores rich in metallic constituents are not treated by the heap method as it is too slow and causes losses due to the solubility of the salt in water. The heap roasting process is simply making large heaps six feet high on high dry ground protected from strong winds by means of a fence, as high winds will fan the fire and cause melting due to the high temperature thus produced. The advantages of this method are cheapness of installation, low operation costs, and small consumption of fuel when the ores are rich in sulphur content.

Stall roasting is as the name implies, small enclosures consisting of three walls and a fourth one that can be removed. The ore is piled into the chamber to about six feet in height and six feet in diameter. The fire is started by wood or other means of ignition. Usually there are a number of these stalls in rooms opposite each other with a channel to pass the air through for combustion purposes.

Roasting in a shaft furnace is a continuous process and is carried on in tall shafts or cylinders varying in size and in height from eight feet to thirty feet. The ore is charged at the top and removed at the bottom in a roasted condition. The air enters at the bottom and is heated by hot roasted ores as it passes to the upper section where the fresh ore to be roasted enters, thereby accomplishing the object of gradual heating of the ores to a certain degree. The shaft furnace is often built with a tapper which reaches down to the bottom of the furnace thereby facilitating removal and passage of the ore. Others are made with the middle section "bushed out" to allow longer passage which allows the ores to remain in the roasting zone for a longer time. Shaft furnaces are used for the calcination of oxides of zinc, roasting iron ore and sulphide quicksilver ores. The use is limited to ores low in sulphur content.

THAT'S WEALTH

A calm devotion to one's native sod,
That's Wealth;
A faith implicit in the Living God,
That's Wealth;
A few choice friends that feel life's fuller meaning,
Who sense reality, yet prize the dreaming,
Who from the skies see knowledge ever streaming,
That's Wealth.

A body sparkling with the health of youth,
That's Wealth;
A mind serenely poised, restrained by truth,
That's Wealth;
An eye that feeds on flowers and fields and skies,
That sees the heaven in a baby's eyes,
That finds in life the door to Paradise—
That's Wealth.

A home among the trees, the blue above,
That's Wealth;
The perfect goodness of a woman's love,
That's Wealth;
The sense to grin when all the world looks wrong,
To take defeat with gameness and a song,
To smile a mile when worry comes along,
That's Wealth.

Chas. F. Steele, in the Spinner.

Reverberatory furnaces handle finely divided ores, maximum four mesh. The gases from the furnace run low in sulphur content and therefore cannot be used for the production of sulphuric acid. The flue-dust must be taken care of as the ore is finely divided and some is blown out into the flue. The air for roasting enters through the grates where the air is heated to a high temperature. It is also allowed to enter through the front doors and over the top of the roasting ore. In the latest type of furnaces the entering air is always preheated. The thickness of the ore on the bed is from four inches to eight inches. Dead roasted ore is spread two inches thick. The principle practiced is to raise the temperature as quickly as possible to the ignition temperature in contact with preheated air and keep the temperature constant for a time and then raise it to the maximum temperature. The time of roasting varies from six to eight hours and in some cases as long as forty-eight hours with a difficult dead roast. The roasting capacity is from ten to seventy pounds per square foot. Two to six hundred pounds of coal are consumed per ton of ore.

The hearth of a mechanically raked furnace may be straight-line, annular, or two or more superimposed hearths. The straight-line single hearth furnace is the most common and is represented by the furnaces of Wethey, Brown, and Edwards. Of the circular type the Pearce turret; and Brown "horseshoe" are used quite extensively. The wedge furnace is of this type and serves in roasting copper ores.

Mechanically raked reverberatory furnaces are employed for rough roasting being better suited for the purpose than hand-raked furnaces. In these furnaces the stirring is frequent and regular, the ore passes through much faster and thus allows more ore to be raked. The possibility of having several fire-places on the side instead of one at the end as it is with the hand-raked furnace, permits making the hearth as long as is desired. Mechanically raked furnaces are used where large tonnages of sulphide ores must be handled which need not be dead roasted.

In the muffle furnaces, ores that do not become sticky in roasting may be treated. They are useful where the sulphur present does not generate heat enough to roast itself. The gases of SO_2 and arsenic can here be used as they are free of carbonaceous gas from the fire for making sulphuric and As_2O_3. In chloridizing roasting the gases are condensed. The furnace may be hand-raked or mechanically raked.

Blast roasting apparatus consists of three types; up-draft, down-draft, and continuous or intermittent up-draft apparatus. The Huntington-Heberlein blast roasting pot is typical for the in-

Sounding a new production note for 1930

with

TIMKEN BEARING EQUIPPED

The new year will put operating and production costs on a new low level in many plants—with Timken-equipped machinery.

For industry has found *the one bearing that does all things well* . . . TIMKEN . . . with its exclusive, wear-defying, cost-cutting combination of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken steel.

And in future years, when the responsibility for continued progress rests on the shoulders of the student engineers of today, "Timken Bearing Equipped" will still be one of the most potent weapons with which to fight waste and inefficiency.

A systematic study of Timken possibilities in all types of machinery will well repay the student engineer.

THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS

termittent up-draft apparatus. The part, A, is the cast iron kettle; F is a perforated cast iron plate serving as a grate; G is a baffle plate for the distribution of the blast entering through the inlet pipe below; B, the brick-work supporting the whole arrangement; C, the detachable hood. D is the off take for gases; and, E, is the dust flue. Continuous up-draft converters have been constructed by Bellenger & Vivian but the details of the apparatus are lacking. Intermittent down-draft pots have been constructed but they are not of great importance.

There are three types of down-draft assemblies: the drum, the horizontal-table, and the straight-line assembly. The straight-line assembly is the most important. It consists of a frame of structural steel supporting a feeding-hopper, and ignition furnace, a suction-box, a pair of endless track circuits to accommodate a train of small trucks, called pallets. The circuit is broken when roasting is to be made by sliding the car off of the tracks on its bottom over the suction-box, forming an air-tight pocket for the blast. A pair of cast sprocket-wheels, turning inside the concentric guide-rails lift the train of pallets from the lower to the upper deck by engaging their teeth with the roller-wheels and launch each pallet in a horizontal path under the feed-hopper and igniting the furnace, and over the suction-box, there is placed a plate, over which the pallets must slide, which serves to prevent any air leakage. After a pallet passes over the suction-box and terminal dead plate, its wheels engage the ends of the circular discharge guides. These are adjusted with the view of raising the pallet about one-half of an inch vertically and thus automatically prying up the cake of sinter and freeing it from grate slots. A breaker-roller prevents the prying action from extending too far back, and tends to form a line of fracture. On reaching the curve of the guides, the pallets one by one drop into the guides, each strikes the pallet which has preceded it and, at the same time discharges its load of sinter-cake, and shakes free the slots of the grates. The weight of the train keeps the pallets fed down to the lower teeth of the sprocket-wheel. The ignitor usually used with this machine is a small coal-burning furnace built of tiles, having a grate area of 10"x30" and burning 500 pounds of coal every 24 hours. The flame after passing over the fire-bridge, is deflected down upon the ore by a brick curtain that can be raised and lowered and is then drawn upward by the natural draft of a small stack or bleeder.

Blast roasting of sulphide ores is not very generally used because of the difficulties encountered in the operation and because a sulphide copper concentrate is easily roasted in a McDougall and more cheaply than by blast roasting. The process carried on in the blast is one of a reduction type. The aim of blast roasting is to roast and agglomerate finely divided metallic sulphide by means of forced draft. This is accomplished by bringing the particles to ignition temperature and separating them from one another and be in contact with fluxes so that the grains of sulphides may be completely oxidized. Also that the heat generated be sufficient to cause the oxides formed to combine with the fluxes and form fusible mixtures or compounds which being pasty at the prevailing temperature cohere to one another and form a lump of more or less scorified material.

Leisure

What is this life if, full of care,
We have no time to stand and stare.

No time to stand beneath the boughs
And stare as long as sheep or cows.

No time to see, when woods we pass,
Where squirrels hide their nuts in grass.

No time to see, in broad daylight,
Streams full of stars, like stars at night.

No time to turn at Beauty's glance,
And watch her feet, how they can dance.

No time to wait till her mouth can
Enrich that smile her eyes began.

A poor life this if, full of care,
We have no time to stand and stare.
—W. H. Davies.

The advantage of blast roasting over oxidizing roasting has been so great that the former process has been almost wholly replaced in lead smelting plants, but has not taken hold in the copper smelting plants due to the fact that a sulphide copper concentrate is easily roasted.

ZRS-4 AND 5, AMERICA'S MONARCHS OF THE AIR

(*Continued from page* 51)

The opening and closing of the doors is propelled by a 200-100 h. p., intermittent-rated, 600-300 r. p. m., 440 volt, three phase, 60 cycle, two-speed wound-rotor-type induction motor equipped with a motor mounted, hydraulic-operated brake, and controlled from an automatic magnetic pushbutton control. The pushbutton station has four buttons—one forward, one reverse, one to permit a jogging operation and one for stopping. The use of two-speed motor operating in conjunction with the slow-down limit switches reduces the impact shock to the doors when coming together at the center of the doorway.

By pressing the forward button, power is applied to the motor with high-speed connections, and the door is automatically accelerated to full speed. The door continues to travel in the forward direction at full speed until it nears the end of travel where it automatically trips a slowdown switch. Tripping the slowdown switch inserts resistance in the motor secondary winding with the result that the speed decreases. A second slowdown switch further decreases the speed until the doors are nearly wide open whence the final stop switch is tripped.

The operating for the reverse travel of the doors is exactly the same as that of the forward travel. To facilitate accurate spotting of the door at any point within the limits of the stop limit switches, a "jog" button is provided. To jog the equipment, the button must first be depressed and then, depending upon the direction of travel required, the forward or reverse button must be held down.

The prevention of sudden shocks of the door when the brakes are applied is realized through means of installing a time lag, secured by hydraulic operated brake.

Although the ZRS-4 is planned primarily for military use, its design is easily adapted to passenger use. Accommodations can easily be built into the ship providing for at least 100 passengers. Space could be provided for staterooms, promenades, lounges, dining salon, and smoking rooms so that the comfort of the passengers can compare with that on any of the large ocean liners. The lack of noise and odors and seasickness, speed of travel over the oceans greater than is possible to any other surface craft, are some of the advantages that will make the airship popular with the traveling public. It, no doubt, will be in the near future when these gigantic ships of the air will be common along the airways of the world carrying passengers and goods with great speed, comfort, and safety.

The information and photographs used in the preparation of this article were obtained through the courtesy of the Goodyear-Zeppelin Corp. at Akron, Ohio.

Many Products—
One High Standard
of Quality!

The products of the Reading Iron Company are varied, but in all of them you will find the same high, uncompromising standard of quality that has made the name of this company famous since 1848.

Reading 5-Point Pipe is made of Genuine Puddled Wrought Iron—the only wrought iron that has been fully tested by time.

Reading Charcoal Iron Boiler Tubes have been known for their great endurance since steam first challenged sail.

Reading Cut Nails, wedged-shaped for a permanent grip, are today the standard where great durability and holding power are required. Reading Bar Iron is the accepted material for use where resistance to corrosion must be combined with immunity to strain and vibration. And Reading Iron Company machinery is noted for its honest workmanship and superior endurance.

We are sure of our products and sure of our service—you'll find it both pleasurable and profitable to deal with us. The name "Reading" is always your guarantee of the finest.

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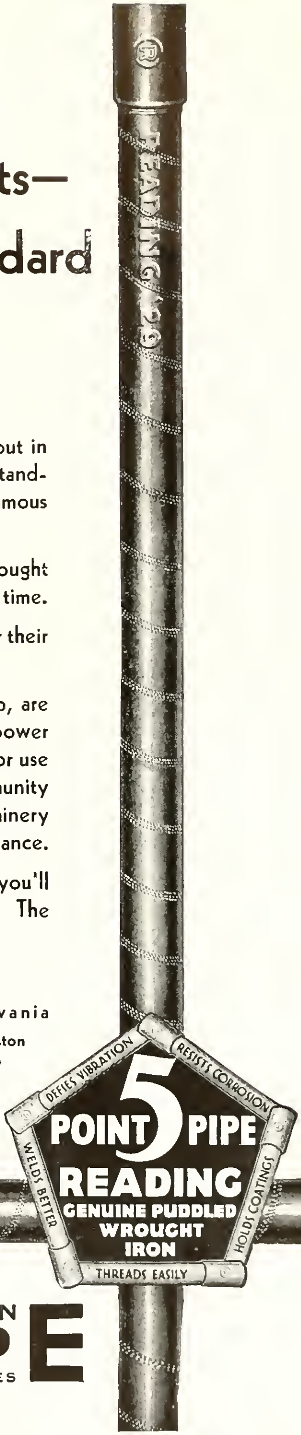
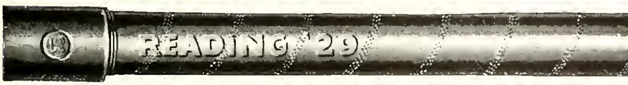




GENUINE PUDDLED WROUGHT IRON
READING PIPE
DIAMETERS RANGING FROM 1/8 TO 20 INCHES

THE ELECTRODEPOSITION OF RUBBER

(*Continued from page 55*)

is of importance, rubber has been successfully electroplated on lead, zinc, tin, cadmium, antimony, certain alloys of these metals, and upon iron and steel under certain conditions. Copper and copper alloys are usually unsuitable, because they throw the rubber out of the solution of the plating bath. The plating is uniform over the surface and covers the edges, corners, and contours perfectly. Adequate stirring in the baths is, of course, necessary as well as are other technical precautions to keep the rubber ion and compounding ingredient ions dispersed, and from precipitating out electrically, *i. e.*, due to the sign of the charge on the ion.

In addition to plating on metal the process can be used to deposit rubber on non-metallic supports. This can be done by impregnating the non-conductor, if porous, with electrolyte, thereby connecting it electrically with the anode placed inside the porous form. If it is not porous the object may be made conducting by graphitizing or metalizing.

The production of certain types of molded goods and of goods now produced by dipping is another promising field. Some applications of this process are the water-proofed textiles, paper, wood, coated metal wire for insulation and protective purposes, coated metal apparatus, such as rubber lined tanks, pipes, wells, screws, pump and valve parts, and similar small metal articles, exposed to corrosive gases or liquids.

In the rubber goods industry, much interest is attached to the possibility for the continuous production of rubber sheets, of rubber slab stock for molded goods, and the direct production of molded or dipped articles by electroplating, such as inner tubes for tires, rubber gloves, finger cots, etc.

From an economic point of view, it is of interest to survey the new process. By dealing with the raw latex which is shipped by tank cars direct from the plantation, all uncertainty as to method of coagulation is eliminated. As latex has a content of about 35 per cent rubber, and is usually shipped that way, an economic loss in transporting a large bulk of water results. However, a number of effective processes of concentrating are being developed. Satisfactory latex of 60 per cent content has already been shipped, and it is hardly too much to expect that higher concentration will soon be possible. Various processes of emulsifying coagulated rubber to form aqueous dispersions have been developed, and these will have an important role in utilizing waste and scrap in the new process.

The cost of mixing the fillers, sulphur, and vulcanizing agents in the liquid state is much less than for solids compounded and the chance of uniformity are greater. Although the cost of current is a large factor, this is not necessarily so serious as to demand location in special districts where power is cheap, but can be carried on wherever power cost does not exceed from four to five cents per kilowatt-hour. There are a number of applications where the electrodeposition of rubber will have a close competition with the old method, but in the new field of rubber plating metal for protective purposes no competition can be found. This field is of interest to the chemical engineer due to the great number of applications that it has.

THE HAMMERS

Noise of hammers once I heard,
Many hammers, busy hammers,
Beating, shaping, night and day,
Shaping, beating dust and clay
To a palace; saw it reared;
Saw the hammers laid away.

And I listened, and I heard
Hammers beating, night and day,
In the palace newly reared,
Beating it to dust and clay:
Others hammers, muffled hammers,
Silent hammers of decay.

—*Ralph Hodgson.*

REMOTE CONTROL BY RADIO

(*Continued from page 53*)

directly would increase the weight of the apparatus materially, and as a pilot is needed for the take off and landing, it is not necessary.

One system uses the crossed coil antenna for the transmission of a beam. This beam antenna consists of two large coil or loop antennas mounted in vertical planes at a fixed angle to each other. Through the proper coupling the antennas are connected to a single transmitter. A mechanical device automatically transmits the letter "A" from one loop and the letter "N" from the other loop in their proper time relation. The signal will spread as it progresses from the loops, but there will be a narrow band where the signal from each loop will be of the same intensity. The sending of the letters "A" and "N" are so interlocked that a continuous long dash will be heard in the headset of the pilot, when in this zone of equal strength signals. The width of this zone will increase as the distance from the transmitter increases but not very rapidly. Captain E. F. French states that the increase is one-fourth mile in 200 miles. If the plane is off to one side the pilot will hear the letter "A" and if off to the other the letter "N", and he can bring the plane back on its course, where the continued long dash is heard.

Another system employs three loops mounted at a slight angle to each other, mounted on the fuselage of the plane. The central loop is mounted parallel to the axis of the plane, so that when flying directly towards the beacon it will be in a position to receive signals at maximum intensity. The loops are mounted at an angle so that when the plane gets off its course one of the outside loops will be in a position to receive at a maximum signal strength.

The signals are sent out in an uninterrupted series and are used, through the proper relays, to light small lamps on the instrument panel. A white light is usually used to designate that the plane is on the correct course, with red and green lights to show which side the plane is off.

ENGINEERING NEWS

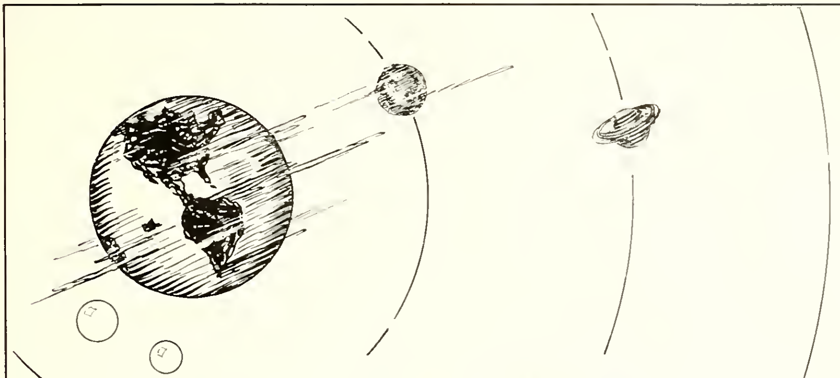
(*Continued from page 57*)

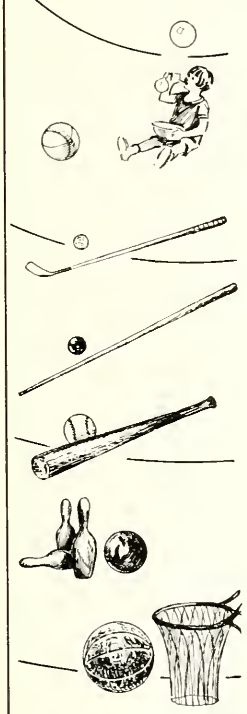
that the engineers require; at the same time saving in the cost of construction is experienced.

World Engineering Congress

Twenty-six countries were represented at the World Engineering Congress, held in Tokio, Japan, October 29 to November 7. It was opened in the new Municipal Building by Prince Chichibu, while Premier Hamaguchi, Baron Furuichi and representatives of other nations were in attendance. On this occasion emphasis was laid by all present on the marvelous industrial progress of Japan during the short period of fifty years since Perry's adventure, and hope was expressed that the experience gained from other countries would prevent injury to the country's natural beauties and age-old culture in the pursuit of future developments. Speakers from all nations stressed the part played by engineering in the advancement, welfare, and economic progress of all countries, the value of the engineering profession being recognized now as never before in official circles.

Beginning with the suggestion fathered by Dr. Elmer Sperry and approved by President Hoover while Secretary of Commerce, this congress





The Sphere is Nature's Favorite Form

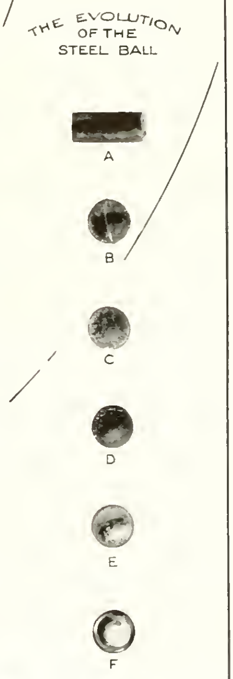
IT has only one dimension, is the only form that rolls in any direction with equal facility, is the most compact and strongest.

In the New Departure Ball Bearing man has capitalized on nature's infallible wisdom and has developed the most successful anti-friction device.

The New Departure steel ball evolves from special analysis wire (A), is "headed" into its first rough form (B), rough ground (C), finish ground (D), lapped (E), cleaned and polished (F) to a brilliant, smooth surface, to absolute sphericity and greater precision in dimension than any other commercial product.

These balls, between raceways of equal quality, finish and precision, become superior fighters of friction losses and preservers of mechanical precision in industrial service.

The New Departure Manufacturing Company, Bristol, Connecticut; Detroit, Chicago, San Francisco.



NEW DEPARTURE

BALL BEARINGS

1221

grew into the greatest conference for the exchange of engineering education on all phases of modern industry, covering the past and the future prospects under most varied conditions. Steam from volcanic heat and electric power generation by windmills are possibilities that were touched.

A dinner given by the American delegates to Japanese engineers was attended by Prince and Princess Chichibu, with many notables with their wives taxing the hotel capacity. Dr. Sperry was toastmaster. Addresses were made by Baron Furuichi, Baron Tukuma, F. B. Jewett, and George Otis Smith.

Chicago was mentioned as the next meeting place of the Congress, the date to coincide with the opening of the World's Fair there in 1933.

Lay High Voltage Submarine Cables

Eight cables carrying two three-phase 60,000-volt circuits, have been laid beneath the Delaware River between Deepwater Point, N. J., and Pigeon Point, Delaware. The distance between the terminal structures is 3,521 feet. The current carried by these eight single conductors will be at the highest voltage ever used on submarine cables. It was necessary to excavate approximately 205,000 cubic yards of material to form a trench 10 feet deep and 40 feet wide in which the cables were laid. A portion of the trench will be backfilled in order to safeguard the cables against ship anchors.

Vacuum Tube Insulation

In pure magnesia, extruded from dies for the proper cross-section and cut to the desired length while in a plastic state, the radio industry has found an insulator which is suitable for use on a. c. tubes. After being cut to the proper size the bases are fired at a temperature of 700 degrees Fahrenheit, a temperature which is higher than any temperature applied to this material. Tubes which have been constructed for two and a half volts with magnesia tubing withstand an overload of eight volts on the filament without disastrous results. With six volts on the filament, tubes have operated for 25 hours. Tubes operated at four volts, instead of the usual two and a half, have enjoyed a life in excess of 500 hours. From these tests it seems that tubes with this type of insulating base will last for several thousand hours, and even in excess of 5000 hours.

A charactertistic of the pure magnesia insulator is that it will not fuse with the filament wire. The insulating base on the average type of base would fuse and combine with the filament wire, and so cause the filament wire to attempt to snap at different stages of cooling and thus cause a premature burn-out.

Smooth Performance

Do you know that the engine in your car manipulates at smoother performance in damp weather than in a close dry atmosphere. Experiments performed by the United States Bureau of Standards prove that motor performance is much quieter in saturated air, but with a proportional diminishing of actual power output. An explanation offered by the Bureau engineers gives a common sense argument in explaining the facts.

When the wet air is drawn into the carburetor and then used to atomize the gasoline, it provides a mixture which possesses a damping effect when ignited in the combustion chamber. As much as a ten percent loss in power has been noted on various types of combustion engines under conditions of saturated air.

Humidity has no effect on the motor which has a correctly adjusted carburetor.

Choice of America's Colleges

TAYLOR STOKERS

At the University of Wisconsin . . .

Purdue
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Catholic University
Wisconsin
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New Hampshire
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In a setting like this the power plant should be smokeless.

College engineers, with a wide and accurate knowledge of the latest scientific advances and demanding the best in modern equipment, specify TAYLOR STOKERS for college power and heating plants.

The University of Wisconsin found that by remodelling its heating plant with TAYLOR STOKERS the necessity of building a new plant could be obviated. The new TAYLOR STOKER installation provided *twice* the capacity of the former heating units.

University of Wisconsin engineers credit TAYLOR STOKERS with helping to reduce the cost of heating from $13.90 per semester per student in 1918 to $18.53 in 1927.

In some colleges the TAYLOR STOKERS are used as part of the laboratory equipment for training engineering students.

AMERICAN ENGINEERING COMPANY
2441 Aramingo Avenue Philadelphia, Pa.

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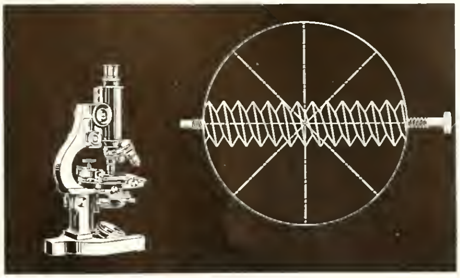


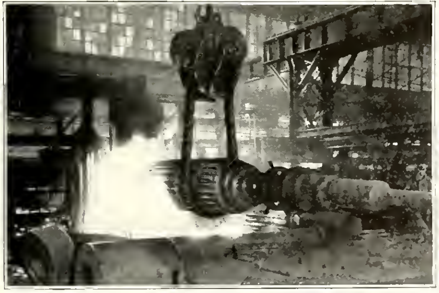
"How can I best inspect precision tools?"

A manufacturer said to us: "I must measure a number of templets frequently. Great accuracy is imperative. An optical method may speed up the process . . . " The B. & L. Toolmakers' Microscope—used in many other industries—was the simple solution to this problem.

In every phase of industry special optical instruments are solving problems of inspection and production control better and more economically. Bausch & Lomb scientists have studied many industrial fields. Their experience may be invaluable to you. Call on them.

BAUSCH & LOMB OPTICAL CO.

635 St. Paul St. Rochester, N.Y.



Heated 48" ingot weighing 60 tons being withdrawn from furnace preparatory to forging into a butterfly valve shaft for a hydraulic turbine.

RESEARCH

A manufacturing company, like an individual, never stands still. It must constantly seek ways to improve its products or it will soon start to go backward.

Allis-Chalmers has made it a policy never to be satisfied with designing and building good machines. They must be built better. Not only are exhaustive tests made to bring out any weaknesses in design or construction and to get data on operation of machines before they are offered to the public but continuous study and field tests bring out points where further improvements may be made.

Working with the manufacturing and engineering departments and supplementing their work are research engineers whose duty it is to develop new kinds of iron and steel, insulation for electrical machinery, and other materials that will give to Allis-Chalmers power, electrical and industrial machinery longer life and trouble-free service.

ALLIS-CHALMERS MANUFACTURING CO.
MILWAUKEE, WIS. U.S.A.

There is a
Tycos or
Taylor
Temperature
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for every
purpose

Taylor Instrument Companies

THE SIXTH SENSE OF INDUSTRY
Tycos Temperature Instruments
INDICATING - RECORDING - CONTROLLING

Armour Institute of Technology

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The College of Engineering Offers Courses in

ELECTRICAL ENGINEERING
MECHANICAL ENGINEERING
CIVIL ENGINEERING
FIRE PROTECTION ENGINEERING
CHEMICAL ENGINEERING
ARCHITECTURE

These courses are each four years in length and lead to the degree of Bachelor of Science

COMPLETELY EQUIPPED SHOPS AND LABORATORIES

The Institute Bulletins

Will be Sent on Application

Use Model Plane in Teaching Control

A new instruction device has been installed for student airplane pilots at the New York University. The pupil in learning the use of this device is situated in a cockpit and works natural sized controls. These controls in turn are connected with a model airplane situated before him. The plane responds to the air currents just as a full sized plane would respond to actual air currents.

The instructor is enabled to give many points which could not be met in the air as often without resulting in a hazardous outcome.

Metal Covered Money

A chemist recently found a method by which paper money can be covered with a solution of metal alloy to make it more durable. A steel alloy is used in the process that was developed in the laboratory of Dr. Schoop in Zurich. This new invention has adhesive qualities which make it remarkable. The paper is not defaced in any way, and forging of this specific type of bank note is practically impossible. The United States Government spends several millions of dollars each year to replenish the supply of paper money which has been worn out from contant use. We may soon be transacting our business with "iron tender."

PAGING LAW PROF.

An old man heard of a famous surgeon who could restore youth by performing a gland operation.

Going to the physician the old man said:

"Could you make me 17 years old?"

"Certainly, I can," the surgeon responded and the operation was performed.

Several months later, the doctor sent a bill.

"Nothing doing," the patient responded. "I am under age and you can not sue me, and if you say I am not under age, I'll sue you for fraud.

A name which for years has identified the finest tapes and rules on the market, regardless of price.

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Analyze a Jenkins

Take a Jenkins Valve apart and analyze it. If it happens to be a Fig. 370, Jenkins Standard Bronze Gate Valve, your analysis will show that the valve is made up of nine metal parts, and asbestos packing.

Note first, how the body, which is cast of virgin metal, is designed symmetrically in both transverse and longitudinal sections to assure intimate contact between the gate and seat. Examine the well turned spindle with strong square threading. The sturdy bonnet, packing nut and the carefully machined wedge.

This simple inspection shows the reason for that long, efficient performance for which Jenkins are noted—performance so unvaryingly dependable that engineers have come to accept Jenkins Valves as standard.

Send for a booklet descriptive of Jenkins Valves for any type of building in which you may be interested.

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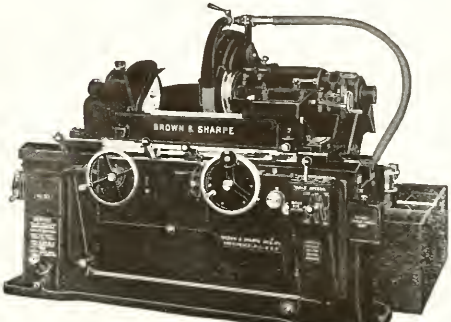
Jenkins
VALVES
Since 1864

Improving Grinding Practice



with the

Brown & Sharpe No. 30 Plain Grinding Machine

THE advanced design and the many unique features of the Brown & Sharpe No. 30 Plain Grinding Machine has led to the development of new methods which increase the production of accurate work, reduce the effort required of the operator and lead the way to substantial new savings.

Among the outstanding features of the No. 30 are the rugged construction, high speeds and feeds, centralized controls, inbuilt precision and ease of operation.

A catalog describing in detail the many features of the No. 30 or any other size in the "30 Series" will be sent at your request.

BROWN & SHARPE
BROWN & SHARPE MFG. CO. BS PROVIDENCE, R. I., U. S. A.

FIRE HAZARDS OF FILM

(*Continued from page 47*)

other means of applying water serve very effectively in quenching the fire. Smothering by foam is also quite useful. While the odor given off by the burning film may irritate the throats and eyes of the firemen, it is not sufficiently serious to deter them from performing their duties. The problem of the fire department is equivalent to that of extinguishing a fire in a storage of similarly placed newsprint paper stock. The automatic sprinkler protection to successfully handle a fire in this situation is practically the same as that for other risks of ordinary hazard. The design of such a system is governed by the regulations of the National Board of Fire Underwriters for the installation of sprinkler equipments.

The results of all investigations conclusively show the merit of employing cellulose acetate films in place of cellulose nitrate films, because of reduced danger to both life and property. Regulations requiring the use of the less hazardous type of film in hospitals and schools have been adopted in several of the large cities. Further development along this line will be watched with interest.

Outlet For Large Quantities of Silver

China and India still continue to be the largest consumers of silver in the world, each consuming about twice as much as the United States. However, the Eastman Kodak Company in this country uses about five troy tons of silver a week. The only order of silver that surpasses this is the one of the United States mint. Most of this silver is used in the manufacturing of more than 200,000 miles of moving picture film a year. The base of safety moving picture film is cotton, which is made into cellulose nitrate, or cellulose acetate.

How To Make a Man of Consequence

A brow austere, a circumspective eye,
A frequent shrug of the "o humeri";
A nod significant, a stately gait,
A blustering manner, and a tone of weight,
A smile sarcastic, an expressive stare:
Adapt all these as time and place will bear;
Then rest assur'd that those of little sense
Will deem you sure a man of consequence.

—*Mark Lemon.*

Automatic Refrigeration

In an automatic refrigeration plant at Harvard University, ice pans are hung from the ceiling in rows. Ice frozen in them holds the surface of the pans at a constant temperature regardless of the warm air that may flow to them from an exterior source. The system maintains the ice pans at 0.5 degrees below freezing so as to do away with frosting the pans.

Mr. Douglas Warner, the inventor, gives the guarantee that he can maintain a temperature of 34 degrees Fahr. for 48 hours with power. The difference in temperature between the refrigerant and the room is said to be only five degrees. If this is the case, the temperature of the refrigerant will not have to be so low, and thereby use a minimum of power. In the Harvard plant the new system made it possible to replace their former 3 HP. motor with a 2 HP. motor.

Brine of various densities is frozen in a pan in the top of cabinets. Numerous copper fins extend from the bottom of each pan into the cabinets, maintaining their temperature the same as that of the frozen solution above. In this manner the desired temperature is obtained by varying the amount of salt put into the water, and not by a fragile thermostatic control.

1855 · SEVENTY-FIFTH ANNIVERSARY · 1930

Measuring the progress of 75 years

From small shops to vast factories . . . from blacksmith's forge to six-ton electric furnaces . . . from Joule's theory of heat to superheat . . . from guesswork to science . . . from waste to economy—these hint the revolution in industry since 1855.

The growth of Crane Co. through these years is a significant reflection of the growth of all industry. From a one-man shop founded three-quarters of a century ago, it has grown to a world organization, meeting in its own factories the power and production problems that have faced other manufacturers. Supplying the piping materials that have released power, effected economies, and increased production everywhere, it has of necessity met and solved piping problems as they have arisen in all industries.

Now in its 75th anniversary year, it serves all industries with the materials developed, the knowledge and experience gained. To engineering students, its customers of the future, it offers a valuable reference book and research manual on metal reactions under high pressure and superheat: "Pioneering in Science." Write for it.

Valves CRANE *Fittings*

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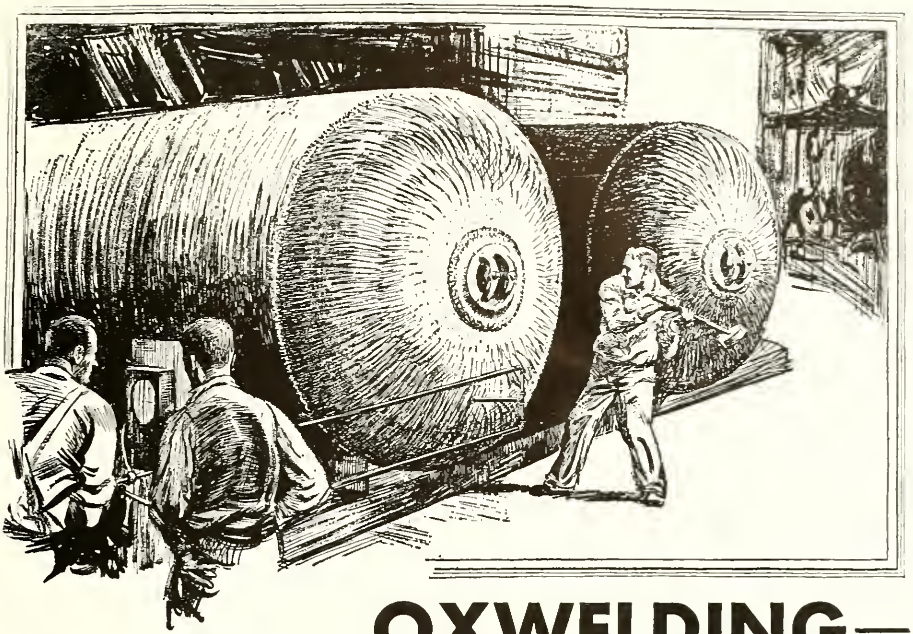

OXWELDING—
PROVED BY TEST

Oxwelded pressure vessels constitute an outstanding example of the results which can be obtained through intelligent application of the oxy-acetylene process. Introduction of oxy-acetylene welding into the production of large pressure vessels has resulted in increased dependability, and noteworthy contributions to the knowledge of the best methods of design.

Never before has it been possible to test full size pressure vessels actually to destruction. With oxwelded construction, however, it has been possible to test each design until the plate itself failed and to correct any weaknesses discovered in design or materials. Test pressures of three times the working pressure are standard for oxwelded pressure vessels.

From time to time the oxy-acetylene industry is in the market for technically trained men. It offers splendid opportunities for advancement.

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Resident Engineer,
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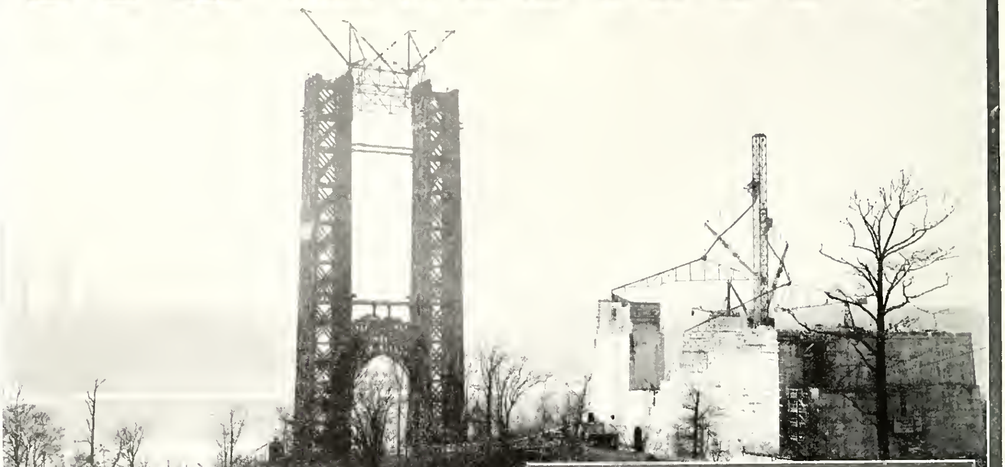
Basketball 4 years
Baseball 3 years

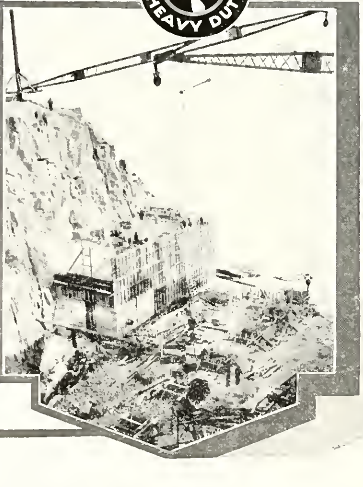
W. S. WALKER
Development Engineer, Engineering Dept.
University of Wisconsin '26
Football 2 years
Wrestling 2 years
Honorary Society
Psi Upsilon Fraternity

[One of a series of advertisements featuring College men serving this industry.]

The Linde Air Products Company — The Prest-O-Lite Company, Inc. — Oxweld Acetylene Company — Union Carbide Sales Company — Manufacturers of supplies and equipment for oxy-acetylene welding and cutting — *Units of*

UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street UCC New York, N. Y.





KOEHRING

Anchorage for the Longest Suspension Span

A bridge with a main suspension span of 3500 feet, the longest in the world, will soon cross the Hudson river at New York. Suspension will be maintained by four 36 inch cables supported on steel towers 635 feet above the water level.

Abutments on the Fort Lee approach are shown in preparation in the views at the right. Two Koehring Heavy Duty products, a power shovel for the rock excavation and a paving mixer for turning out the Dominant Strength Concrete, were used in this work.

The massive New York anchorage above, 200 feet by 300 feet ground dimension and 125 feet in height, contains 110,000 cubic yards of quality controlled concrete mixed by two Koehring Heavy Duty Mixers.

Another identification of the Koehring re-mixing action with a structure built to endure!

The revised edition of "Concrete — Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, is now ready for distribution. To engineering students, faculty members and others interested we shall gladly send a copy on request.

KOEHRING COMPANY
MILWAUKEE, WISCONSIN
Manufacturers of
Pavers, Mixers—Gasoline Shovels, Cranes and Draglines
Division of National Equipment Corporation

Curled Hair

. . . . *Provides a World of Comfort!*

This is the second of a series of advertisements dealing with the products of the by-product activities of Armour and Company that will appear in this and in subsequent issues of the Armour Engineer.

SLEEP! Seldom do we pay heed to its importance. If we did, we would provide for it more carefully. Sleep is of utmost importance to us. The average person must have approximately eight hours sleep each day to repair bodily wear and tear—and that period of restfulness and upbuilding should be had under the most favorable circumstances.

Essential to proper sleep is a good mattress. Preferably it should be a Curled Hair mattress because of the many exclusive advantages to health and comfort to be found in this type of mattress.

Leading hotels, hospitals, government institutions and the U. S. Navy and other organizations that know the value of sleep to the human body through scientific study, use and endorse Curled Hair Mattresses—and in addition regularly use and endorse Armour's Quality Curled Hair as the mattress filler. They know it to be the standard of quality in Curled Hair.

In the Curled Hair field, producing a product which contributes greatly to man's health, comfort and welfare, Armour and Company is a leading factor. Thirty-three years of manufacturing experience together with their unusual facilities for obtaining raw materials and processing them, have won for them a leadership.

Where Curled Hair is used, "Armour's Quality" is a synonym for "absolute uniformity"—this, in a sphere of industrial activity where uniformity is all-important.

Armour and Company are one of the leading manufacturers of sterilized Curled Hair; they are one of the largest importers of horse hair—South American horse hair only is imported by them, it being the finest obtainable; and they are the largest producers of domestic hair other than horse hair.

Hair from horses tails and manes, domestic cattle tails and domestic hog hair—these are the principal raw materials used in the manufacture of the curled hair that goes into the making of mattresses, furniture upholstery, automobile seats and cushions, and many other things. Vegetable fiber is also used, and is blended with the animal hair where a cheaper grade of product is wanted.

There is a romance of business built into the gathering and processing of these raw materials.

The horse tails and manes are obtained from South America. There they are clipped from semi-wild horses by natives who follow this occupation as a means of livelihood. These clippings are put up in 900 pound bales and then shipped to this country. More than 1,500,000 pounds are brought in annually. The hair is of a superior quality. Montana, Texas, and the horse-raising ranches of Canada provide additional supplies, though not large.

The cattle tail hair which Armour and Company uses is obtained almost exclusively from our own packing plants. The same applies to hog hair. Thus, in both these sources of supply, Armour and Company has first choice of the finest materials.

Approximately 1,000,000 pounds of cattle hair are produced annually in America; and about 15,000,000 pounds of hog hair.

The vegetable fibers are obtained from Mexico.

Careful processing of cleansing, sterilization, bleaching, and spinning which produces the curl in curled hair, attends the making of the finished product.

Being leaders in this field, Armour and Company maintain splendid laboratory and research facilities for the benefit of the curled hair user. These facilities are by far the most up-to-date in the industry. Through them a constantly improved product has been made possible; problems of curled hair usage have been solved, and thousands of dollars have been saved to curled hair users. In the interest of the industry, this service is provided free of cost.

If your problems, now or later, involve the use of Curled Hair, we urge your logical consideration of our services.

ARMOUR CURLED HAIR WORKS
Owned And Operated By
ARMOUR AND COMPANY
1355 W. 31st St., Chicago, Ill.

Six Reasons Why Your Mattress Should Be a Curled Hair Mattress:

1. **Permanently Resilient**
   Curled Hair contains thousands of miniature spiral springs that respond to the slightest pressure.
2. **Non-absorbent**
   Curled Hair does not absorb moisture or odors.
3. **Self-Ventilating**
   Curled Hair insulates against heat in summer and cold in winter.
4. **Doubly-Sterilized**
   Curled Hair is highly sanitary—does not easily retain dust.
5. **Long Life**
   Curled Hair will outlast all substitutes—can be easily and economically renovated.
6. **Economical**
   While first cost may be slightly higher than substitutes, less is required due to greater resiliency and filling qualities.

UP FROM THE OXCART

"Acceleration rather than structural changes, is the key to an understanding of our recent economic developments"—From the report of President Hoover's Committee on Recent Economic Changes

YESTERDAY, the rumble, creak, and plod of cart and oxen. To-day and to-morrow the zoom of airplanes. Faster production. Faster consumption. Faster communication.

Significant of electricity's part in the modern speeding-up process is the fact that during the last seven years, consumption of electric power increased three and one-half times as fast as population.

General Electric and its subsidiaries have developed and built much of the larger apparatus that generates this power as well as the apparatus which utilizes it in industry and in the home.

The college-trained men who come every year to General Electric take a responsible part in the planning, production, and distribution of electric products, and at the same time receive further technical or business training.

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 9 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC

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GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

The ARMOUR ENGINEER

VOL. XXI. MARCH, 1930 NO. 3

Published Quarterly by the College of Engineering
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Chicago, Illinois
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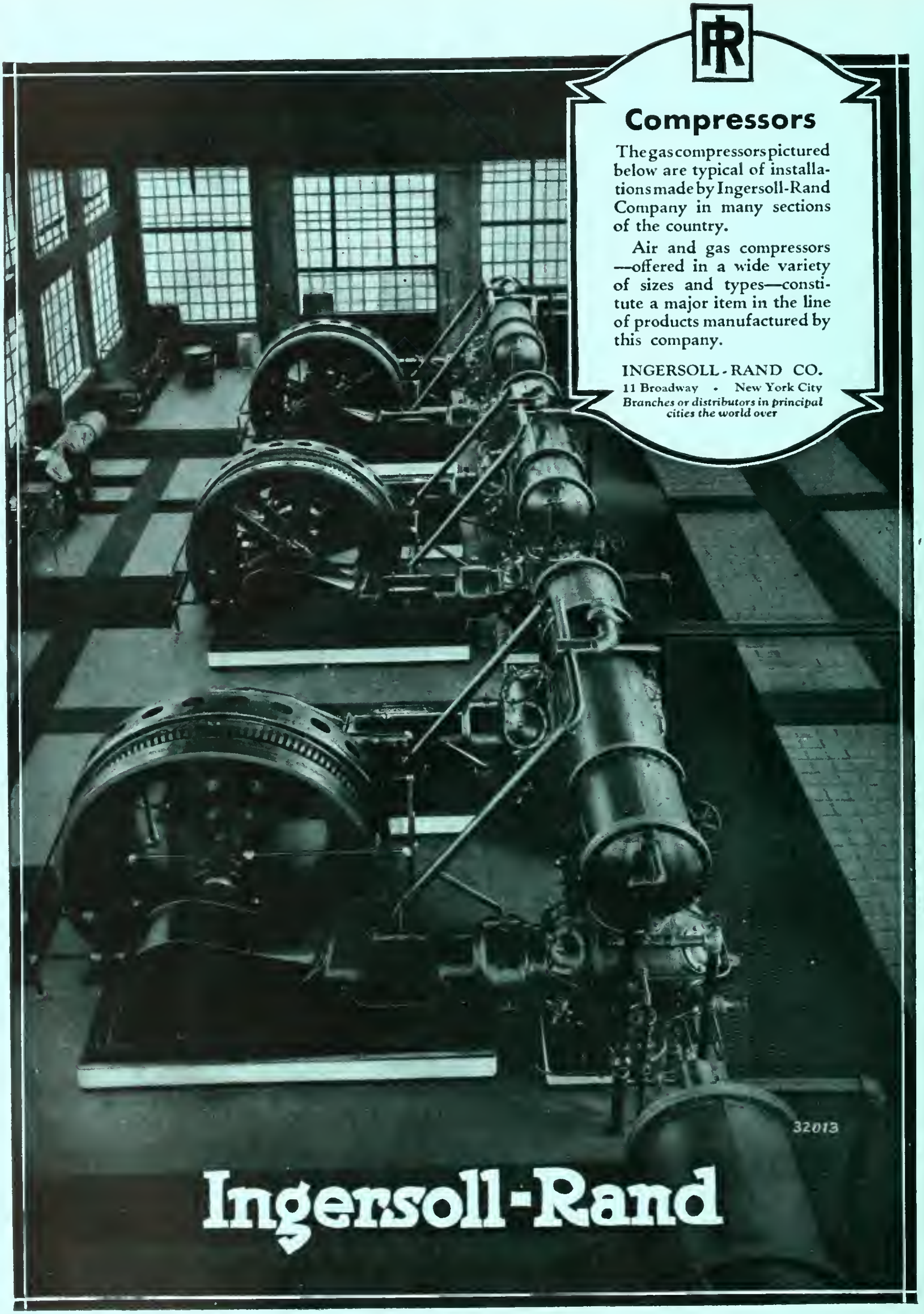

Compressors

The gas compressors pictured below are typical of installations made by Ingersoll-Rand Company in many sections of the country.

Air and gas compressors—offered in a wide variety of sizes and types—constitute a major item in the line of products manufactured by this company.

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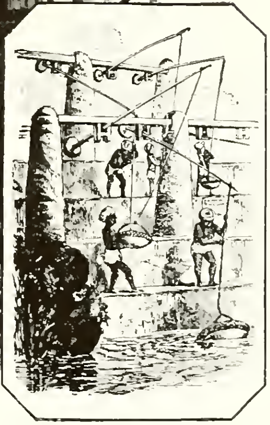


One of the early phases of Vertical Transportation

A New Chicago Skyscraper

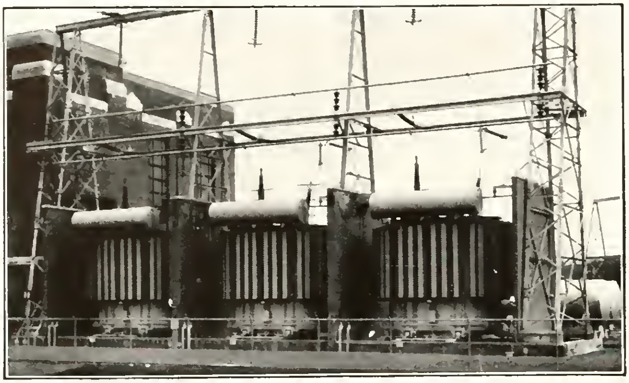
THE Palmolive Building, Chicago, although completed only a short time, is already a famous office building. It is served by 12 Otis Signal Control Elevators for passenger service.

In such an outstanding structure as this it is imperative that nothing but the finest equipment be used and Otis Elevators, with their world-wide reputation for safety and reliability, were the natural choice.

Over 75 years research and manufacturing experience are behind Otis Elevators, which are made by the same organization that has pioneered the way with every important development and major improvement in the entire field of Vertical Transportation.

OTIS ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

WHAT YOUNGER COLLEGE MEN ARE DOING WITH WESTINGHOUSE



Special cars were needed . . .

railway tracks had to be lowered, to handle the transformers these men built

At CONOWINGO, Maryland, is the second largest hydro-electric development in the world. Power generated there at 220,000 volts will be fed into lower voltage transmission lines of the Public Service Electric and Gas Company at Roseland, near Newark, New Jersey.

The transformers that will perform this transfer of energy are physically the largest ever built, for their capacity is sufficient to serve the home lighting needs of a city of a million people. Four in number, each is larger than a house, weighs when empty as much as a large locomotive and holds three tank cars of oil. Four specially built railway cars and fifty-two standard cars of various types were required to transport them from the factory to the job. At one point the railway tracks had to be lowered so the units would clear an overhead viaduct, so great was their size.

When spectacular jobs like this come up it is natural that they go to an institution like Westinghouse. Pioneers in electrical development, Westinghouse engineers often know the thrill of achieving the "impossible" in seeing their work through from design to erection.

Westinghouse

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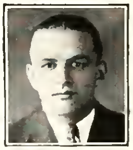
University of Kansas, '25
Development of Commercial Design

R. L. BROWN
Ohio State University, '22
Tap Changer Development

EMIL STEINERT
University of Minnesota, '25
Electrical Designer



A. C. STAMBAUGH
University of Pittsburgh, '24
Engineer of Tests

H. H. WAGNER
University of Illinois, '27
Designing Engineer

THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

VOLUME XXI MARCH, 1930 NUMBER 3

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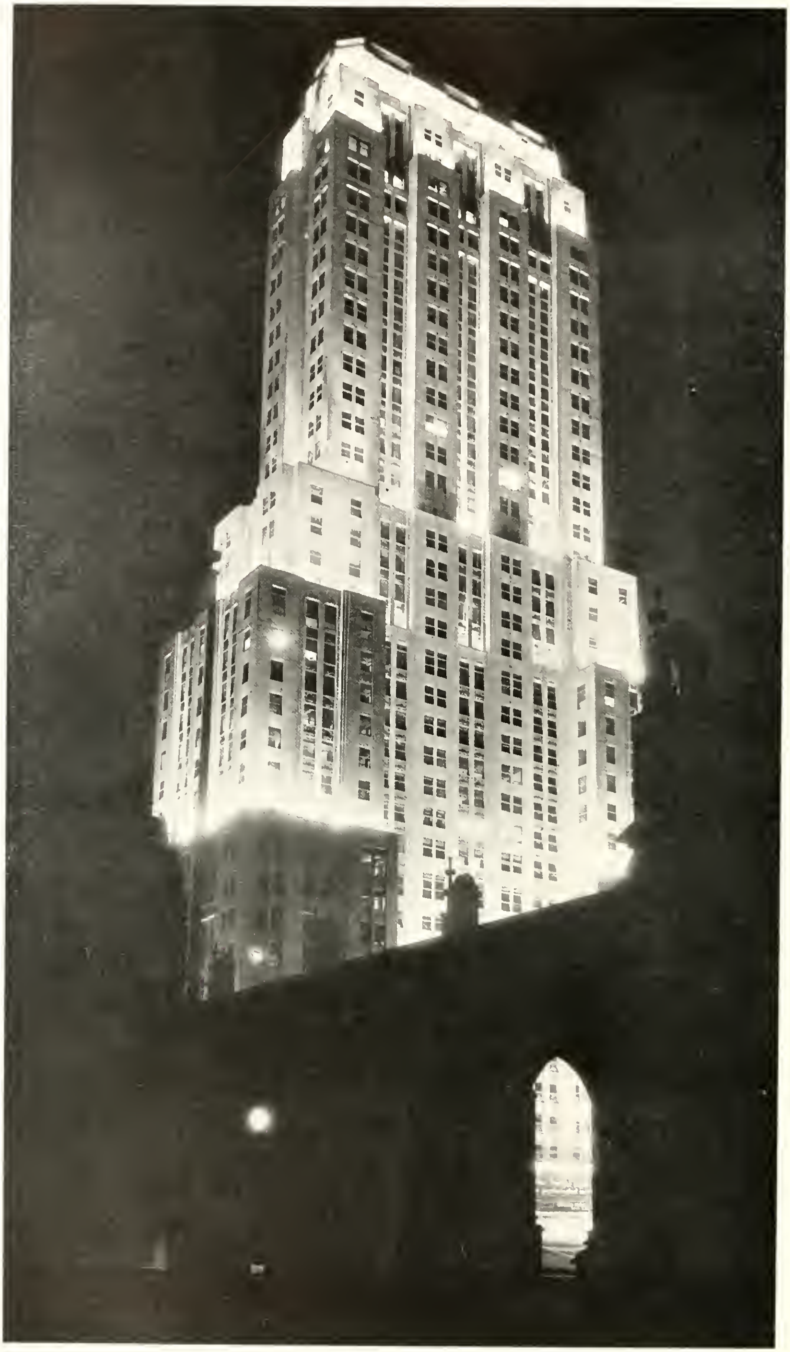


The Palmolive Building, Chicago

The
ARMOUR ENGINEER

VOLUME XXI MARCH, 1930 NUMBER 3

Precision Frequency Determination

By **Beverly Dudley, ex-'30,**
Assistant Technical Editor, Q. S. T.

THE precise determination of frequency is a most important radio engineering problem. It is highly desirable that the frequencies within the range of audibility be quite accurately known as a matter of academic interest but the increasing economic, social, and political importance of radio channels makes the precise determination of radio frequencies an absolute necessity, for it is a serious matter when radio signals transmitted from one station trespass on the frequency channel assigned to another station. The importance of the subject may, perhaps, be better appreciated when it is realized that the problems involved are international rather than merely national in scope, so that not only must every nation using radio communication systems employ accurate radio frequency standards, but in addition these standards must be in very close agreement with the frequency standards of other nations.

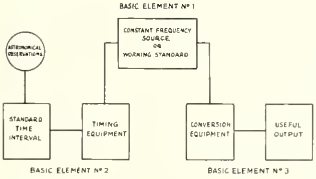


FIG 1
GENERAL FREQUENCY DETERMINING SYSTEM

Since frequency may be defined as the number of complete recurring events taking place during a given time interval, it follows that the determination of frequency is little else than the determination of a certain time interval. The complete recurring events are called cycles and the unit of time is usually the second. Alternating currents such as are used to light our electric lamps and operate motors usually have a frequency of 60 cycles per second. The time interval required for the completion of one cycle is consequently 1/60th of a second. Frequency and time are therefore seen to be reciprocal values representing the completion of a certain event. Frequency is determined when the time interval of a single recurring event is known. The standardization of time is therefore necessary for the precise determination of frequency.

The Solar Day is the time interval between two successive transits of the sun across the meridian of the observer. The length of the Mean Solar Day (which is the mean or average length of all the Solar Days in a year) is taken as the standard interval of time. The acceptance of the Mean Solar Day as the standard of time permits the use of the rotational frequency of the earth about its axis as the primary frequency standard, although 1/86,400th part of the Mean Solar Day or one second is a much more convenient time interval unit.

Given the primary frequency standard it is possible to determine the frequency of any series of recurring events in terms of this standard. For general electrical and radio use an accurate working standard which may take the form of a vacuum tube oscillator or generator is used, the frequency of this generator being compared with the primary frequency standard, which was taken to be the rotational frequency of the earth about its axis. That this intermediate step, making use of the working frequency standard, is essential may be appreciated when the difference between the frequency of the primary standard and the frequencies desired from the working standard is realized. The rotational frequency of the earth is once every twenty-four hours. The frequency of commercial alternating current lighting circuits is 60 cycles, or 60 complete recurring events, per second, which is considerably greater than the rotational frequency of the earth. To be exact, if 60x60x60x24, or 5,184,000 cycles take place in exactly twenty-four hours, the frequency of the alternating current will be exactly 60 cycles per second, and the accuracy with which this frequency is known will depend upon

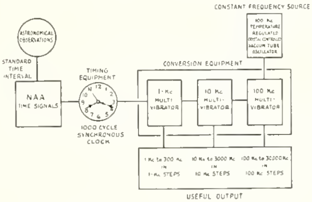
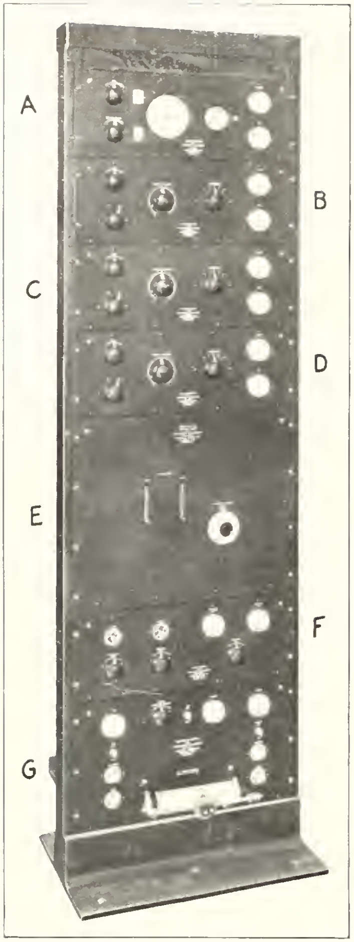

CONSTANT FREQUENCY SOURCE
100 Kc TEMPERATURE REGULATED CRYSTAL CONTROLLED VACUUM TUBE OSCILLATOR
ASTRONOMICAL OBSERVATIONS
STANDARD TIME INTERVAL
NAA TIME SIGNALS
TIMING EQUIPMENT
1000 CYCLE SYNCHRONOUS CLOCK
CONVERSION EQUIPMENT
1 Kc MULTI VIBRATOR
10 Kc MULTI-VIBRATOR
100 Kc MULTI-VIBRATOR
1 Kc to 300 Kc IN 1 Kc STEPS
10 Kc to 3000 Kc IN 10 Kc STEPS
100 Kc to 30000 Kc IN 100 Kc STEPS
USEFUL OUTPUT

FIG 2
PRACTICAL FORM OF FREQUENCY DETERMINING SYSTEM



Courtesy QST

Commercial Frequency Standard Assembly. Units indicated by letters are:

A—Timing unit with the amplifiers and synchronous clock.
B, C, D—Multivibrators.
E—Temperature controlled crystal controlled oscillator unit.
F—Power control panel for temperature control unit.
G—Power control panel for complete assembly.

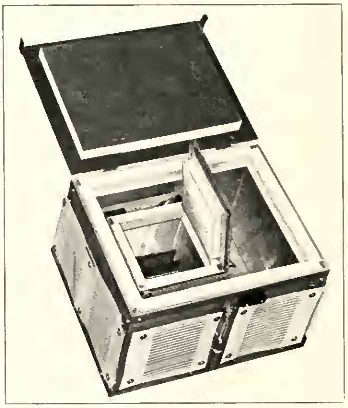
the precision with which the length of the Mean Solar Day is determined, as well as upon the precision with which the exact number of recurring events taking place within this time interval is determined. But 60 cycles per second is turtle's pace compared with some of the frequencies encountered in radio communication, for it is frequently essential to know precisely frequencies of the order of 30,000,000 cycles per second. If we can measure accurately 1/30,000,000th part of a second, or what amounts to the same thing, if we can compare a given time interval with our primary frequency standard and determine the exact number of recurring events taking place in this time interval, it will be possible to precisely determine the frequency of 30,000,000 cycles per second. This process is not nearly so difficult as it first appears.

In a general frequency determining system, such as we are discussing, there are three basic elements making up the system. These are shown in Fig. 1. We must, first of all, have a generator or working standard of frequency whose frequency can be maintained constant over very long periods of time. We must, secondly, make provision for determining the frequency of the working standard in terms of the primary standard time interval, and finally, once having the working standard compared with our standard time interval it is necessary to obtain from the working standard a sufficient number of frequencies to be useful (without undue tedious interpolation) in the precision determination of frequency. There would be no use in going through with the first two steps if the third could not be fulfilled, for then we should have no definitely known frequencies for calibration or measurement purposes.

There are several possible methods of arranging and operating each of these three essential elements of the frequency determining system, but only the system developed at the Massachusetts Institute of Technology and used by Bureau of Standards and a few well known communication laboratories in this country will be dealt with. It is neither possible nor advisable to deal exhaustively with the subject.

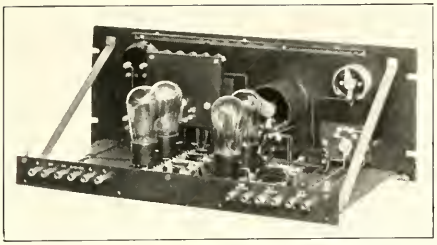
A block diagram of a practical frequency determining system is given in Fig. 2. This diagram corresponds in all respects to the more general diagram, but gives a more definite idea of the required components of a practical system of frequency determination than does Fig. 1. It is true that in Fig. 2 the constant frequency source is shown coupled to the timing and conversion equipment in a slightly different manner than is indicated in Fig. 1. This makes no real difference, for in both cases the constant frequency source controls the timing and conversion equipment, the conversion equipment in the latter case being used to provide a convenient gearing ratio between the frequency of the constant frequency source and the frequency of the timing equipment.

The best working standard of frequency which we know of at the present time is a piezo-electric, crystal controlled vacuum tube oscillator. It is found that when an electromotive force is applied to the opposite surfaces of a slab of crystalline quartz, the shape of the crystal varies slightly, and conversely, if the shape is made to change, an electromotive force appears on opposite faces of the crystal. Because of this piezo-electric effect, properly cut plates of crystalline quartz can be made to vibrate at a frequency which is almost entirely dependent upon the physical dimensions of the plate. If an alternating electromotive force, having a frequency approximately the same as the natural period of vibration of the quartz plate is applied to the crystal, the crystal will oscillate or vibrate continuously as long as the potential is applied. If this alternating voltage is obtained from a low power vacuum tube oscillator the quartz plate will keep the frequency of the oscillator in step with its own natural period of oscillation and maintain the frequency of the vacuum tube generator constant to a high degree of accuracy. If the temperature of the crystal is kept constant, the vacuum tube operated at constant filament, grid, and plate voltages, and other refinements added, the frequency of the piezo-electric crystal-controlled vacuum tube



Courtesy QST

Details of the Temperature Regulated Crystal Controlled Oscillator. The 100-kc. crystal may be seen in the center of the inner box. The oscillator tube and equipment, together with its isolating amplifier are placed in the space at the right of the inner box.



Courtesy QST

A Multi-vibrator With Input and Output Amplifiers.

oscillator may be kept constant to within a few parts in a million. In practical frequency standards (as well as in many radio transmitting stations) constant temperature crystal-controlled oscillators are therefore used as the working standard of frequency. Such an oscillator forms the first basic element of the frequency determining system.

Usually a quartz slab or plate, cut so that the natural period of vibration of the crystal is 100 kilocycles (100,000 cycles per second), is used to control the frequency of the vacuum tube oscillator. Frequency dividers, part of the conversion equipment, are employed to provide a convenient operating ratio between the frequency of the source and the timing equipment so that the frequency of the working standard may be accurately compared against the primary standard interval of time. An arrangement of two vacuum tubes, known as a multi-vibrator or sub-multiple generator is used with the oscillator to provide the proper electrical ratio for this purpose.

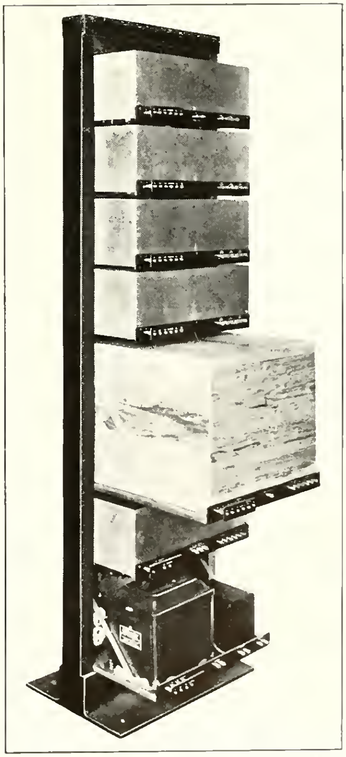
A multi-vibrator is essentially an unstable electrical generator consisting of two vacuum tubes with their input and output circuits coupled together through a series of condensers and resistors. When the current in the plate circuit of one of the tubes is exactly the same as that in the plate circuit of the second tube the multi-vibrator will not function. But this is a condition of unstable equilibrium, and any slight surge which causes a change in the plate current of the first tube reacts through the condensers and resistors in the multi-vibrator system so as to produce a change in the grid voltage of the second tube. A variation of grid voltage in a vacuum tube is simultaneously accompanied by a change in the plate current of that tube. The plate current variation in this second tube acts on the circuit in such a manner as to alter the grid voltage of the first tube, which, in turn causes the plate current of the first tube to change again and we find that we have completed one cycle of operation. The process repeats itself, the grid voltages and plate currents of the two tubes in the multi-vibrator alternately increasing and decreasing and so building up an alternating current in the circuit, the frequency of which depends upon the electrical values of the condensers and resistors in the circuit. The operation of a multi-vibrator is somewhat analogous to that of a "motor-boating" resistance coupled amplifier.

A desirable property of multi-vibrators is that the generated oscillations are not sinusoidal but contain many harmonics of large amplitude which are always exact integral multiples of the fundamental frequency of oscillation. If care is used, harmonics as high as the 300th from the multi-vibrator may be used for calibration purposes. It will therefore be apparent that if the output of the 100 kilocycle working standard is coupled to and made to control the frequency of a 100 kilocycle multi-vibrator, we may obtain from the multi-vibrator frequencies from 100 kilocycles to 30,000 in steps of 100 kilocycles. The output of this 100 kilocycle multi-vibrator may be coupled to a 10 kilocycle multi-vibrator which will be kept in synchronism by the 100 kilocycle multi-vibrator. This is accomplished by making the 100 kilocycle multi-vibrator control the tenth harmonic of the 10 kilocycle multi-vibrator, and if the frequency of the tenth harmonic of a multi-vibrator is accurately known, the fundamental as well as all harmonics will have known frequencies which are exact integral multiples or sub-multiples of the controlling frequency. Although this operation appears to be a case of the tail wagging the dog, the system is an entirely practical one.

The output of the 10 kilocycle multi-vibrator in this system controls the tenth harmonic of a 1 kilocycle multi-vibrator which provides frequencies in 1000 cycle jumps from 1 kilocycle to 300 kilocycles. If necessary, additional multi-vibrators or frequency dividers may be provided to supply lower or higher frequencies, but generally the 1 kilocycle, 10 kilocycle, and 100 kilocycle frequency dividers are sufficient for all practical purposes. With the constant frequency vacuum tube oscillator controlling the three multi-vibrators in series we may obtain frequencies from 1000 cycles per second to 300,000 cycles per second in 1 kilocycle jumps; frequencies from 10 kilocycles to 3000 kilocycles in 10 kilocycle steps, and frequencies from 100 kilocycles to 30,000 kilocycles in 100 kilocycle steps. The fact that these harmonic frequencies overlap so that a given frequency may be located on two or even three multi-vibrators is a decided convenience for calibration purposes or for checking the operation of the multi-vibrators.

Sometimes, for the sake of economy or where the requirements for very high frequency calibration do not have to be met, the 100 kilocycle multi-vibrator is dispensed with and the crystal-controlled oscillator is

(*Continued on page* 110)



Courtesy QST

Rear View of Commercial Frequency Standard Assembly.

The Manufacture of Electrolytic White Lead

By I. G. Katz, '30

Student in the Department of Chemical Engineering

WHITE lead is used primarily as a pigment and as such dates from the earliest times. White lead is the oldest chemical pigment known to man, and is therefore of interest for its antiquity and history as well as for its scientific information concerning ancient methods of manufacture.

During the time of the ancient Greeks, Theophrastus and Pliny successively prepared the compound which later was designated white lead, although their preparation was a mixture of white lead and sugar of lead. The old Dutch process, which has been the chief source of this basic pigment and is in use today, is symbolic of the clumsiness and the homespun methods which have characterized its manufacture. The process consists in the placing of sheets of used), the action that stone-ware pots which are about one-fourth full of vinegar. The pots are covered with wooden boards and buried under spent tanner's bark. After a month or five weeks, the reaction is complete and the product that is obtained is white lead. Although this process produces a white lead which is inexpensive, nevertheless the crudeness of the method and the lack of accurate control over the product that is formed do not quite meet the modern requirements in white lead. Industry, today, requires that the product be under accurate control at every stage of the process.

These requirements have therefore been the force which has directed attention away from older methods to more modern means. Although many improved processes have resulted, only two or three can be termed commercially successful. The utility of white lead is in its covering power which increases with its density and the material is more efficient the nearer its composition is to $2PbCO_3.Pb(OH)_2$, the pure normal carbonate being quite useless. The method which has been found to yield a superior product on an economical, commercial basis is the Sperry process, the invention of Elmer A. Sperry. This process has been in operation at the East Chicago plant of the Anaconda Lead Products Co. since 1919; the increasing production of this plant combined with its departments of experimental work and research speaks well both for the success of the process in the past and for its success in the future.

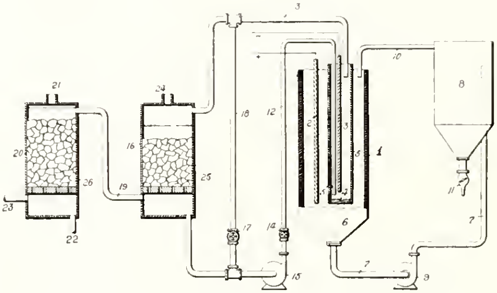


Fig. 1 Basic diagram of the white lead cell, showing the essentials in the preparation of the product.

The Sperry process is an electrolytic one and the process is illustrated in Fig. 1. The white lead is produced in the cell 1 in which are the two electrodes. The anode *2* is a lead plate, and the cathode 3 may be of any conducting metal although iron or copper is used almost exclusively. The cathode is surrounded by a diaphragm 5, usually of heavy linen duck. The presence of the diaphragm divides the cell into two compartments, the anode and cathode, which are entirely independent save through the diaphragm; solutions of different composition circulate continuously and rapidly at a temperature of about 50° C. through each compartment, known as the anolyte and catholyte respectively.

The anolyte is a solution of $NaC_2H_3O_2$ (about 4.6%). The catholyte is a solution containing approximately the same amount of $NaC_2H_3O_2$, and a relatively large amount of Na_2CO_3. The $NaC_2H_3O_2$ is used to provide a solution of high conductivity, and as an intermediate product in the formation of white lead. The amount of Na_2CO_3 present regulates the acidity of the electrolyte, and is a determining factor in the character of the white lead formed. The anolyte may contain some Na_2CO_3 and when it does, the ratio of the concentration between the electrolytes influences the kind of the product obtained.

When the current is applied at the two electrodes (a current density of 30 amperes per square foot and a cell voltage of 3 is used), the action that occurs may be described briefly as follows: Lead is dissolved from the surface of the anode and migrates toward the cathode. The passage of the current through the cell not only attracts the ionic constituents of the electrolytes, but also decomposes the water into H and OH ions. The CO_3 ion from the cathode compartment, migrates towards the anode, passing through the diaphragm into the anolyte. Since the CO_3 and OH ions are much lighter than the Pb ion, these ions will meet near the anode—in the anolyte compartment. The presence of the negative ions with the Pb forms a precipitate of $2PbCO_3.Pb(OH)_2$. Since the solutions are circulating rapidly, the precipitate is carried out of the reaction chamber as soon as formed.

This, in brief, is the electrochemical phenomena that takes place in the cell. Although the description just given is complete in a general sense, yet a large number of variables enter the operation to determine the quality and quantity of the product. These variables, such as the voltage between the electrodes, the current density, the rate of circulation of the solutions, the constituents of the two electrolytes, and their respective ratios, the temperature, etc., are all important factors in the control of the product. These have required a great deal of experimental work to establish a simple method of control and to yield a product which will meet the requirements of industry. This control has been simplified to such an extent that all important variables are reduced to the composition of the two solutions.

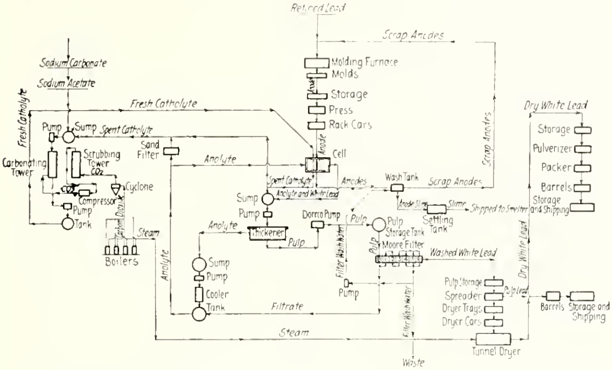


Fig. 2. Flow sheet of the East Chicago plant, showing the various stages in the treatment of the white lead and the by-products.

With the formation of the precipitate in the anolyte, the solution is allowed to flow through the tapering portion 6 of the cell, through the pipe 7, into the settling tank 8. The precipitate here settles out of solution and is taken off through 11. The clear anolyte, by means of pump 9, is sent back through the pipe 10 into the anolyte compartment to recommence the cycle.

On the other hand, the catholyte enters the cell clear and leaves it clear; however, it leaves deficient in CO_3. The catholyte is removed from the cathode compartment by pipe 13, and enters the carbonating tower to be replenished for its deficiency in CO_3. Flue gas containing CO_2 is used to carbonate the catholyte. This gas is first passed up through the scrubbing tower 20 which is charged with limestone. A stream of water is also passed down through the tower by means of pipe 21. The purified CO_2 leaves the scrubber through pipe 19 and passes up through the descending catholyte in tower 16, which is charged with coke 25. The replenished catholyte leaves through the bottom, and by means of pump 15, is sent back to the catholyte compartment. The excess CO_2 passes out into the atmosphere by pipe 24.

Although the preceding discussion offers a general picture of the process, nevertheless the commercial plant involves many more complications. An inspection of Fig. 2 will show many details which have required attention and considerable work in order that the process might function efficiently and which have not been mentioned as yet. A few details of the operation on commercial scale are now given.

This white lead plant has a capacity of from 10 to 100 tons of dry white lead per 24 hours, depending upon the current density employed. The cell room shown in Fig. 3 contains 49 cells of 18 anodes each, with the electrodes connected in parallel and the cells in series. The electrodes are contained in a rectangular concrete tank with a hopper bottom. The anolyte is led into the anode compartment by means of hard rubber tubing and is drawn off from the bottom to an inverted siphon discharge. The anode is a rectangular lead pipe 20x31½x1 in. and weights about 250 pounds. Common desilverized lead is used—the purity of the white lead produced is independent of the lead anode. The impurities present are recovered in the form of slime. The slime is dark grey, extremely fine, and adheres to the anode as a smooth, spongy coating slightly increasing the resistance of the system. It has the following average composition:

Silver, oz. per ton	33.3
Lead, per cent	66.17
Antimony, per cent	1.86
Arsenic, per cent	0.08
Copper, per cent	0.06
Zinc, per cent	0.40
Bismuth, per cent	10.35

About 250 pounds of this slime are produced each 24 hours. To remove this coat of slime, the anodes are removed at 12 hour intervals and washed. The slime is recovered and sold.

The catholyte is supplied to each cathode compartment by means of separate rubber tubings; it circulates through the compartment, and overflows through another pipe at the top. The hydrogen that is formed by the decomposition of the water can be seen forming a froth at the top of the cathode compartment. Steel sheets, $^1/_{32}$ in. thick, form the cathodes, each of which is enclosed by the diaphragm of heavy linen duck and supported by a hard rubber frame.

The two electrolytes enter and leave their respective compartments and circulate through the plant in two distinct systems. The anolyte is fed to each cell from 16 to 18 gal. per min. the rate of circulation of

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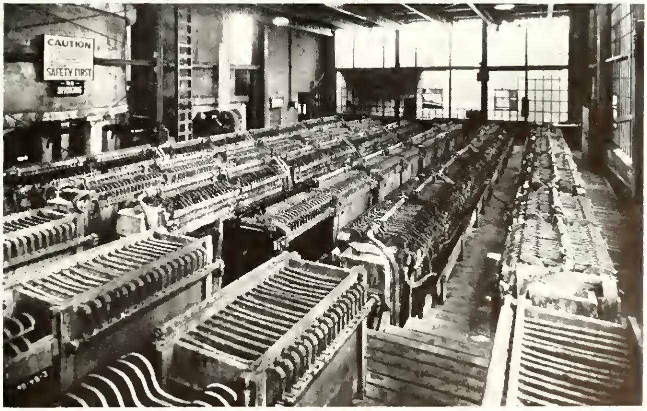


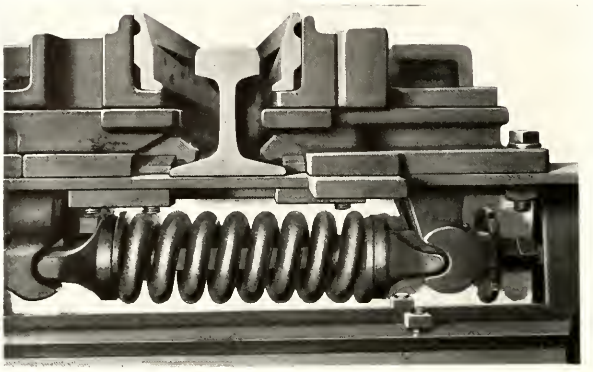
Fig. 3. The interior of the cell room. Part of the equipment for treating the electrolytes can be seen in the background.

The Car Retarder-An Outstanding Railroad Invention

By C. L. Stempkowski, '32

Student in the Department of Chemical Engineering

A COUNTLESS number of safety and labor saving devices are constantly being introduced into all of the branches of industry. The importance of such improvements is obvious, for they serve to perpetuate the growth of the commercial world. Among the latest inventions, conceded by many to be the outstanding railroad invention of the century, is the railway car retarder. It is simply a mechanical brake for railroad cars. The car retarder is used almost exclusively in switching yards, where the cars are moved about, detached from the air brake lines. This system of applying brakes to un-coupled cars was performed by men who mounted the cars and revolved the hand brake wheel.



Cross section view, showing trunnion spring, brake shoe and rail.

The car retarder serves a two-fold purpose in the railroad industry: one as a labor saving device and the other, perhaps bearing a greater significance, as a safety device.

The development of the invention was an outgrowth of years of labor dating back to 1907, when E. M. Wilcox, now Master Car Builder of the Indiana Harbor Belt Railroad, Hammond, Indiana, originated the idea. In the succeeding years he expended a good deal of his efforts in improving the device, later joining with George Hannauer, late president of the Boston and Maine Railroad, with whom he worked jointly, until they realized the completion of a satisfactory car retarder. The device is now known as the Hannauer-Wilcox car retarder.

The feasibility of the car retarder is evidenced by the results that are being produced. Today there are over 31 such systems in the United States and the installation of additional systems is being prompted continually. The system has not only attracted nation wide interest, but international as well. Scores of visitors from every civilized country in the world have called upon E. M. Wilcox, the surviving co-inventor, for information concerning the patent.

It is only six years since the system was first put into use. The original installation was made in the Hammond, Indiana yards of the Indiana Harbor Belt Railroad in 1923. During the first year one retarder unit was used for experimental purposes. In the following year, after the tests had revealed satisfactory results, the Markham, Ill. and East St. Louis, Ill. yards of the Illinois Central Railroads adopted the system. Other railroads throughout the country followed.

As a safety device, its importance has been proved, for it has cut the accident and death rate at the switching yards to a far greater extent than any other device, despite all precautions that were taken in the way of promoting safety campaigns and "no-accident" weeks.

One railroad company had reported an average death rate of five employees annually, through accidents occurring to car riders. During the last six years, the time since the car retarders were installed at this point, not a single death blotted their records. The railroad company is justified in boasting that thirty lives have been saved as a result of the new car retarder system. Along with the minor and fatal accidents, considerable expense in the form of sick benefits and insurance would accrue, same aggregating a total of $50,000 per year. This, likewise, has been saved.

The system further enables the railroad company to operate on a more economical basis. The company using car riders, would consider the handling of 300 to 400 cars per day the maximum for a 26 track classification system. Since the time of the installation of the new device, the same company can handle 3000 cars with ease and can regulate its output to meet its needs, regardless of weather conditions.

All of the large switching yards are of the hump design, that is, the rails are inclined to an approximate 4 per cent grade. The design of the hump was advented to speed up the movement of the cars. In the flat surfaced yards, a considerable amount of time was wasted while the engine was in the process of moving backward and forward each time a car was to be sent down to the classification tracks. After the hump system came into use the railroads remained quite satisfied that their switching problem was solved and no further improvement was practical.

Now the new retarder system proves that the switching work was comparatively slow, for the switching work has increased in speed tenfold.

If the yard is not graded, the system is not practical. In the level surfaced yards the engineer regulates the speed of the cars which are sent down the classification tracks. If the engineer shows any amount of caution he will not send the car down the rails with any great speed, consequently brakeage will not have to be applied to the cars.

Hump switching, under the older methods was done with a car-rider crew and a locomotive. The engine would provide the force to send the car up hill, while its extended journey down grade was taken care of by gravity. This method is known as the gravity distribution system.

After the locomotive pushed the cars to the apex, they would be uncoupled from the train, one at a time. The car riders were then obliged to mount the cars and apply the hand brakes whenever necessary. If a 75 car train was to be made up on a certain classification track its length would amount to about 3000 feet. Naturally the first car to be spotted for this freight train would need very little brakeage. As the number of cars increased on the track, more brakeage would have to be applied each time a car went down the grade, for all the cars gain the same amount of speed, yet their distance of travel was shortened.

This procedure endangered the workmen's lives and at times resulted in serious car collisions that caused considerable damage, when the brakes failed to function. Many cars, like the hopper coal cars and high box cars, did not provide the car rider full accessibility to the wheel of the brake shaft, situated on the deck of the car. In that event the car rider would be compelled to use the lower brake level, where he would have to use the "rachet and dog" brake. At times his tool would slip or the shaft chain would break and an accident would result.

Such hazardous conditions are entirely absent where the car retarder system is in use. The work is done by switch operators who are comfortably situated in elevated towers, placed near the series of car retarder units, where the effects of each operation is visible to the operator. The operator simply cuts in the electric current at the moment the car approaches the switch or retarder. He may apply the pressure to the retarders just before the car approaches the retarder or when it is over it.

Every car on leaving the engine passes through two retarders; the first is placed at the foot of the hump, (the apex), the second on the classification track where the car is to be spotted.

The retarder unit is a simple constructed device, as shown by the illustrations. In order to safeguard against the elements, the movable parts and springs are concealed. It measures about 40 feet in length and is constructed in sections which may be removed for emergency repair needs. The sectioning of the retarder further serves to prevent the car from climbing the rails. If the retarder were one solid unit, there would be a tendency at times for such an occurrence, but with the sectioned unit, there is a slight decrease in resistance after the wheels pass from one section to the other. If the wheel was on the verge of climbing the rails, it would sink to its normal position the moment it passed the five foot section.

The sections are so constructed that the greatest resistance to the wheels is effected when the wheel is in the center of the five foot section. After the wheel passes through the center of the section it is not gripped so tightly until it comes into the center of the adjoining section. This serves to explain that it would be impossible for a car to climb the rails because there are times when the pressure applied against the wheels is very slight and the weight of the car would force it down to the rails.

One unit, as the brake shoe, comes in contact with the wheels, providing the friction that slows up the car. The brake shoe is of the inverted "L" design, protruding about four inches above the rails. The wearing surface is the horizontal flange of the inverted "L." The flange measures two inches at the cross section and is prepared of carbon steel. In manufacturing the brake shoe, precaution is taken to produce a steel which will provide the desired amount of friction and yet will not be injurious to the metal wheel. The brake shoes are removable and are replaced when worn. There is also a series of trunnion springs, supporting the brake shoe holder, which serve to cushion the shock when the car enters the retarder. The springs also safeguard against a possible interlocking of the wheels in the retarder. If too much pressure should be applied against the wheels, the hazard is overcome through the compression of the springs. Four pressures are applied against the wheels, varying with the weight and speed of the car. The four variations in pressure are used as follows: first position, empty cars; second, light loads; third, medium loads; fourth, heavy loads.

Information concerning the condition of the loads is conveyed to the towermen from the agent's office. Each tower and agent's office is equipped with loud speakers, microphones, and teletype receiving machines for the communication system. The loud speaker and microphone is placed over each control panel so that the towerman may speak and receive messages without leaving his control position. These instruments enable the operators to be advised promptly of any changes in the switching list, or of other facts concerning the work.

The teletype machines are connected with transmitting machines located in the general agent's office.

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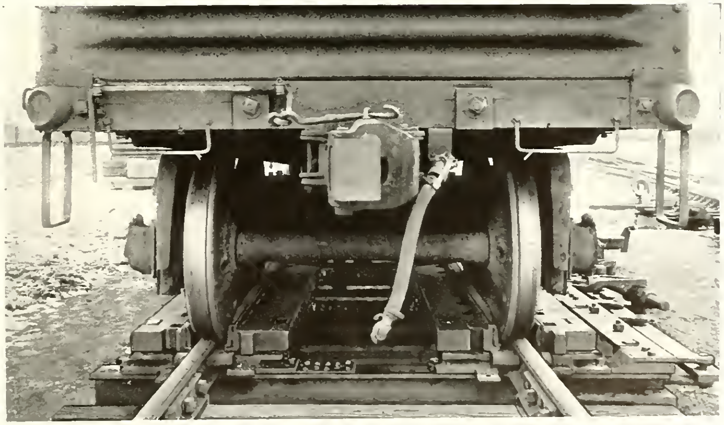

Car in the retarder unit showing brake shoes pressed against wheels

Recent Developments in Electrical Engineering

By Professor E. H. Freeman

Head of the Department of Electrical Engineering

IN the earlier periods of any art, the development is usually relatively slow followed by a period of more rapid progress. Such a growth has been displayed in the field of electrical engineering. Beginning, let us say roughly, fifty years ago with the invention of the telephone, with a practical form of the incandescent lamp and with generators of commercial sizes, these five decades have shown a continuously accelerating progress but the last decade has displayed a rate of growth far exceeding anything previously experienced.

Indicative of this development, let us observe a little of the evidence relating to this country for the past ten years. The use of electrical energy in industry has increased about three-fold and the use of mechanical power has decreased from less than one-half to less than one-fifth of the total industrial power used. This country now uses more power in industries in proportion to its industrial population than any other country in the world, and the output per workman is correspondingly greater.

Similarly the use of electric lamps has increased about three times in the last decade. This increase has taken place in all lines—factory, office, store, display and residence lighting. In the increased use of light in industry and commerce, there has resulted more and better work. We can now do things under artificial light which, a few years ago, were considered practically possible only with natural light. In display lighting such as signs and flood lighting, we have achieved beauty in form and color far beyond anything previously attained. The neon tube has been an important contribution in this field. In residence lighting, we now have 70 per cent of the homes of the country wired for electric lamps while less than 30 per cent were so wired ten years ago. Such wiring has also greatly extended the use of electrically operated household conveniences, many of which, formerly considered luxuries, are now looked upon as practical necessities.

Telephones have increased in numbers from twelve to twenty million in the last decade. There is now one telephone for every six persons while there was one for every nine ten years ago. This increase, however, does not equal the increase in use. We now have 80 million conversations per day over telephones, double the number of ten years ago. Due to the development of trans-oceanic telephony by radio and to the extension of interconnections by wires, it is now possible to interconnect 85 per cent of all of the telephones of the world, a total of about 30 million telephones—two-thirds of these being in the United States.

Professor E. H. Freeman

In another field of communication, telegraphy, the oldest using electricity, we had another rapid advance. The use of the telegraph has increased about five-fold in the last decade. The most striking contribution to this development is the increased use of the printing telegraph which has made possible greatly increased speeds, hence a more attractive service for business uses. About 90 per cent of all telegrams are now sent by printers; twenty years ago, about 90 per cent were sent by Morse code. The speed is now such that the main-office-to-office time for a short mesage between Chicago and New York is not more than two minutes for the fastest service.

In the development of radio as another means of communication, we have had a very rapid growth in the last ten years. While broadcasting has developed commercial aspects, it is commonly looked upon more in the nature of entertainment by the general public. The improvements here have been in the nature of improved quality both in sending and receiving together with the use of larger powers, particularly for sending. The use of radio for communication without advertising features has also grown rapidly. It has made possible trans-oceanic telephony, talking from ship-to-ship and between ship and shore as well as between airplanes and ground. The practical design of the alternating-current type of tube and the use of tubes with four and five electrodes are among the more recent developments in the radio field.

Due to the great demand for energy in the electrical form, there have been some striking changes in magnitudes connected with its generation and distribution. We now have a single-unit generator rated at 165,000 kva. What this means is almost incomprehensible, but one writer has tried to make it easier by saying that such a generator could light a highway extending twice around the world. The output from electric generators, both large and small, now amounts to nearly 100 billion kilowatt-hours, an amount between three and four times that of ten years ago.

In order to transmit large amounts of energy economically, the voltage on over-head lines has been raised to 220,000 volts. For underground cable, the pressure has been increased to 132,000 volts, a value not commercially practically at the beginning of the decade.

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Recent Developments in Chemical Engineering

By Professor Harry McCormack

Head of the Department of Chemical Engineering

THE developments of importance in chemical engineering during the last few years have been as usual, along the lines of designing new equipment for well known processes, designing equipment for new processes about to be installed, and the development of new processes from the experimental stage to actual factory operation.

Some of the lines of chemical activity in which the chemical engineer has had his part in carrying out the program of research and development are touched on quite briefly in this paper.

The synthetic production of methanol from carbon monoxide and hydrogen is one of the chemical industries which has shown marked development in recent years. Five years ago there was no synthetic methanol produced in this country, but in 1929 the production had reached over 3,000,000 gallons. The part the chemical engineer has taken in this industry has been primarily that of developing proper equipment for handling these combustible gases at high pressure and moderate temperature.

The production of butyl alcohol from corn by the Weizmann process of fermentation has developed from nothing up to about 50,000,000 pounds per year. Proper reaction vessels and proper arrangement of the manufacturing process have been the contribution of the chemical engineer to this industry.

Synthetic amyl alcohol has been produced from natural gases since 1927 and the production at present runs up to possibly 10,000,000 pounds per year. This is another high temperature, high pressure reaction where special equipment has had to be designed to carry out the process satisfactorily.

Other high pressure, high temperature reactions, which have in recent years been carried through the experimental stage to commercial production, are those in which other constituents of natural gas as ethylene, propylene, and butylene are used in synthesizing ethylene glycol, ethylene dichloride, and the glycol ethers. The production of these materials adds up to about 15,000,000 pounds per year.

Professor Harry McCormack

The production of synthetic ammonia by the catalytic combination of hydrogen and nitrogen at a high pressure and at a comparatively high temperature has developed from nothing to an industry of considerable magnitude. In fact, most of the anhydrous ammonia used in this country today is made by this process; the indications are that the process will continue to be operated more and more economically so that the ammonia produced in this way may be oxidized to nitric acid and the product so obtained compete in price with the nitric acid manufactured from imported sodium nitrate.

Some of the chief problems in this development of synthetic ammonia process have been those connected with obtaining proper equipment to withstand the high pressures and high temperatures at which it is necessary to operate in order to secure satisfactory yields.

It should be noted from some of the prior comments that the reactions carried out at high pressures and high temperatures are those in which considerable development has taken place.

An accompaniment to the development of these industries has, of course, been the securing of data as to the behavior not only of the reacting materials at the high temperature and high pressure necessary, but also obtaining data as to the behavior of the materials which might be used in constructing the equipment. The investigations along both of these lines are by no means complete. Much additional data need be obtained to aid in the development of all these processes.

A chemical engineering accomplishment of considerable interest and one whose commercial importance can not yet be fully predicted is the production of anhydrous aluminum chloride in quantity and at a low price.

Anhydrous aluminum chloride has been produced for years, but in no particular quantity and at a comparatively high price. It has been used in certain organic syntheses and could, undoubtedly, be used in others.

The Texas Company commenced the investigation of the production of anhydrous aluminum chloride at least fifteen years ago; after a long period of investigation, a process was developed and installed which is capable of producing large quantities of anhydrous aluminum chloride at a low price.

The uses of silica gels and activated carbons as promoters of chemical reactions are continually being increased. New methods of using these materials together with some new methods of increasing their efficiency continue to be discovered. As these discoveries are made, the chemical engineer is attempting to apply them in factory operations where they may be useful.

One of the fastest growing chemical industries in this country in recent years has been that of rayon.

(Continued on page 118)

Recent Developments in Fire Protection Engineering

By Professor J. B. Finnegan

Head of the Department of Fire Protection Engineering

DURING the ten years now ending, the fire protection engineer has had to deal with some new hazards and new protective equipment, but to a great extent the work of the decade has been development and expansion in fields in which much work had been done already. In this period new developments in engineering and in industry have made it necessary for the fire protection engineer to adapt and apply principles that were already familiar, and to see that progress in design and manufacture should not be accompanied by corresponding increase in fire loss.

After the war the industrial uses of nitro-cellulose products increased in importance. Pyroxylin lacquers displaced many other materials previously used as finishes for wood and metal. Furniture factories, automobile body plants, and other industries installed equipment for using these lacquers, frequently under hazardous conditions. The convenient and usual method of applying the finish is by means of a spray nozzle, connected to a source of air under pressure. The volatile inflammable solvents employed in the lacquers contribute to the hazard, but the most serious danger is due to the residue of pyroxylin which accumulates on surfaces in the immediate neighborhood of the work. This residue decomposes at temperatures as low as 230° F., and the decomposition is commonly followed by rapid combustion. The problem of safeguarding this new and extreme fire hazard involves the construction of standard booths, properly ventilated and provided with automatic sprinkler protection; the elimination of steam pipes and lighting fixtures situated where pyroxlin residue may settle; and scrupulous attention to safe and thorough methods of cleaning. "Good Housekeeping", of conspicuous importance in this case, is one of the basic principles which finds innumerable applications in fire protection.

The calamity of last spring at the Cleveland clinic, called public attention to a situation which had been a matter of grave concern to fire protection engineers — the accumulation of large quantities of nitrocellulose x-ray films in hospitals, under conditions which involved great danger to life. Largely on account of the Cleveland tragedy, it has become possible to bring about compliance with proper standards for the storage of hazardous films, and better yet, to replace much of this objectionable material with the comparatively safe acetate film. Another important hazard of hospitals, the use of ethylene and of other combustible anesthetics in operating rooms, has had careful study, and the resulting recommendations of fire protection engineers are being adopted rather widely.

Professor J. B. Finnegan

The National Electrical Code, in its successive editions, has become even more firmly established in its position as a standard which expresses the authoritative decisions of all those most qualified to pass on questions of electrical installations. One interesting development in the electrical field has been in the use of gas-tube signs, which have changed the problems of electric sign design and installation from the field of low voltage to the region of 10,000 volts, or more. Self-contained electric lighting systems, each comprising a generator driven by a gasoline engine, with a storage battery floating on the line, are coming into use in buildings where public-service electric current supply is not available. In many cases such systems replace other more hazardous lighting methods. It is interesting to note the evolution of this kind of lighting system from mechanisms which were first developed as the ignition, lighting, and starting devices for motor cars.

Lightning is an important cause of fires, especially in buildings in sparsely settled neighborhoods. The lightning-rod salesman found that this situation made his work easy, and unscrupulous sales and careless installations of equipment have been rather common. Many a farm owner has had reason to assume lightning rods and gold bricks to be in the same class. In recent years, listing of standard materials, preparation of standard specifications, and careful supervision of installation of lightning protective equipment have had conspicuous effect in reducing the number of fires. A building provided with standard protective equipment is almost entirely safe from lightning.

The use of gasoline as fuel for motor cars has become so much a matter of course that there is a tendency to forget the great fire hazard of the material. One of the real achievements of the fire protection engineer has been the development of devices and methods which have made it possible to store thousands of gallons of gasoline, without catastrophe, in a single city block.

In public fire departments, the use of horse-drawn apparatus has been decreasing rapidly for many years. Now, instead of a "steamer" drawn by horses and accompanied by a hose wagon, we have a motor-oper-

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Recent Developments in Mechanical Engineering

By Professor G. F. Gebhardt

Head of the Department of Mechanical Engineering

PROGRESS in the broad field of mechanical engineering during the past five years has been rapid but not spectacular. Improvement has been the result of systematic development and refinement in design rather than the outcome of any revolutionary discoveries or radical changes. The race for higher technical efficiencies is still on, but the pace is being moderated to meet the demands for increased financial returns. Technical efficiency has closely approached the theoretical maximum in some branches of mechanical engineering and further improvement in this direction is commercially impractical. The past five years have witnessed larger mergers of invested capital, larger plants, larger equipment units, larger inter-connection of central stations, in short, the single word "magnitude" is more descriptive of this advance.

In the power generating field the steam plant ranks by far the highest, in point of installed capacity and yearly output, the hydro-electric second, and oil and gas power, third. This order is not likely to be changed for years to come despite the intensive development of water power and the steadily increasing use of oil and gas power. Statistics show that the potential energy of all the rain falling on the United States between the level at which it falls and the sea level, if converted into power, would not exceed by more than 10 per cent the power equivalent of the present coal consumption on a basis of 2 pounds of coal per kilowatt hour. Furthermore, cheaper fuels and improvement in plant design and efficiency have made it more difficult for many water-power developments to compete with steam. Water power, however, will be developed as long as there are sites available, although the immediate expense of these developments may result in a unit cost of power exceeding that of modern steam plants. This apparent anomaly is due to the fact that these two sources of power are complimentary rather than competitive, since it is a recognized fact that the load requirements of large power systems can be more economically supplied by a suitable combination of hydro and steam plants than by steam power alone.

Professor G. F. Gebhardt

Inter-connection and inter-change of power between systems permit the installation of larger turbines and steam-generating units than would be advisable without. Furthermore large units cut down unit investment costs, cost of labor, cost of supplies and maintenance. Turbine units of 100,000 kilowatts and over are becoming common and several steam-generating units are in service capable of evaporating 600,000 lb. of water per hour. The largest steam turbine unit in operation is the 208,000 kilowatt triple compound turbo-generator at the State Line Generating Plant, Hammond, Indiana, and a single steam generating unit in the East River Station, New York City, evaporated 1,200,000 lb. of water during a special test.

While the trend is toward higher steam pressure and temperatures, the present maximum temperature limit of 750 Fahr. has divided the newer stations into two major groups, one operating at pressures up to 450 lb. without reheating and the other between 600 and 1400 lb. with reheating. Careful study has shown that 450 lb. is about the maximum throttle pressure for 750 degrees which can be carried without excessive moisture in the lower stages of the turbine. That the 750 degree limit will soon be extended is evidenced by the new equipment ordered for the San Antonio Gas and Electric Company (1400 lb. pressure and 810 Fahr.) and the plant now being erected for the Philip Carey Company (1800 lb. and 800 Fahr.). The Detroit Edison Company is experimenting with steam taken from the regular station superheated main and raised to 1000 deg. fahr. in a separately fired superheater and has ordered a 10,000 kw. turbine to operate with 365 lb. pressure and 1000 deg. temperature. This installation is purely experimental and few engineers expect this high temperature in commercial operation in the immediate future.

There are several plants in Europe operating with pressures in the neighborhood of the critical pressure (3200 lb. per sq. in.) but none in the United States.

The trend in fuel firing is decidedly toward pulverized fuel and while there appears to be no limit to the capacity of pulverized fuel furnaces the progress of the stoker is impressive. There are now available underfeed stoker units capable of burning 15 tons of coal per hour.

Air heaters have been increasingly used both with and without economizers. Higher pressures have increased the importance of feedwater heating while decreasing that of evaporation. As a result in the modern high pressure stations, the total surface of air heaters, reheaters, bleeder heaters, water-cooled furnace walls and economizers has in-

(*Continued on page* 116)

Recent Developments in Civil Engineering

By Professor A. E. Phillips

Head of the Department of Civil Engineering

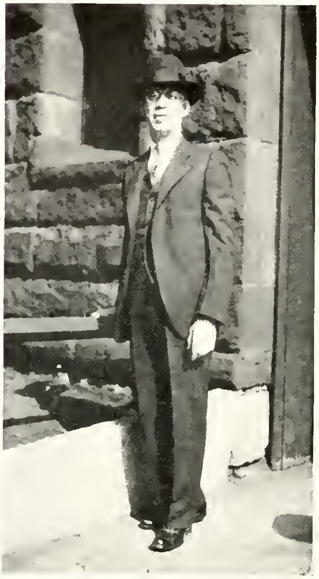
THE field of Civil Engineering is extremely broad in its scope. Included in it are the various phases of sanitary engineering, structural engineering, aeronautical engineering and railway engineering.

The use of public water supplies is no longer considered a luxury, but an absolute necessity in matters of comfort and health. Such supplies, however, must be sufficient in quantity and of proper quality, to keep pace with a reasonable but increasing rate of consumption on the one hand, and on absolute safe supply on the other. New plants must be built, and old plants must be rebuilt and enlarged to meet the demands of an increasing population.

A public supply system loses much of its value unless provision is made to carry off the liquid wastes resulting. Therefore a sewer system becomes a necessary adjunct of every up-to-date community, whether it seeks only to dispose of its organic wastes, or seeks also to improve conditions by removal of storm water. New sewer systems are being built and old systems are being extended.

Purification of water supplies and sewage purification are well nigh universal at the present time. These form problems and opportunites for the civil engineer in addition to other problems of disposal of garbage, refuse and municipal sanitation. Storage of vast quantities of water, either for normal consumption, irrigation, or power development are other engineering opportunities. The automobile has radically changed the habits of the American people. Without hard roads, the development of the motor car would have been impossible, and until the advent of the motor car the development of a system of hard roads made slow progress and, in many communities, no progress at all. However, the civil engineer is today actively engaged in building and extending our hard road system involving the expenditure of millions of dollars, and the end of it all nobody can foresee.

Structural engineering is principally concerned with bridges, tall framed buildings and those whose roofs span large clear floor areas; in fact, all constructions in masonry, steel and timber that require analysis for strength in their design.



Professor A. E. Phillips

The present trend is toward greater refinements in design, permitting the use of higher working stresses, and thereby more economical use of material. In particular, structures that are statically indeterminate are now used more than formerly, because of their greater economy, notwithstanding somewhat less certain in stress determination.

Methods of analysis are being continually improved and extended to the solution of structural problems of great complexity. Because of the tedious and complicated computations required for many of these solutions, methods of stress analysis by means of models and accurate deformation measuring apparatus, have recently been developed and applied with considerable success.

Development of design procedures along these lines, calls for engineers with intensive training in underlying theory, and with insight and seasoned judgment to properly appraise the uncertain factors involved. For the simpler structures generally used in the past, engineers of the "handbook" type, with a rather limited grasp of fundamentals, could make a pretty fair showing.

Large bridges are being built in greater numbers than ever before, particularly to fill in serious gaps in the major highway systems. The 3500 ft. span suspension bridge over the Hudson in New York City will be almost double the longest spans now in existence. Recent suspension bridges at Philadelphia (1750 ft.) and Detroit (1850 ft.) exceed previous records. Steel arch bridges of about 1600 feet span, under construction at New York and in Australia, greatly exceed the previous record (Hell Gate 977 ft.). Many new crossings of large rivers and bays while not requiring spans of such record-breaking proportions, are being spanned by notable bridges of various types.

Even greater bridge projects are being considered for the future, spans of 4000 to 5000 feet being needed for crossings such as Golden Gate and New York bay. Improvements in materials such as the development of higher strength steels at moderate cost, and possibly new forms of structures will bring such projects nearer to actual construction.

In the building field the role of the structural engineer is somewhat subordinate to that of the architect, the structural designer providing the skeleton for the conception of the architect. The recent increase in size and complexity of steel (and reinforced concrete) frame structures is evident on every hand. This has presented many new problems to tax the ingenuity of the structural designer, particularly in providing resistance to wind. In some locali-

(*Continued on page* 114)

The Armour Alumnus

VOL. V J. Warren McCaffrey, '22, Editor No. 3

Dean Monin Writes to Alumni, Faculty, and Students

Alumni Favor Plan of Annual Banquet in the Fall

At the luncheon meeting of the Alumni held Tuesday, February 11, at the Chicago Engineers' Club we were entertained by Professor Wallace Bruce Amsbury. For about one-half hour he delighted his audience with some of his characteristic readings and two splendid word pictures of Abraham Lincoln.

The only business to come before the meeting was a discussion about changing the constitution and by-laws of the Alumni Association so as to provide for holding one annual banquet and general meeting of the Association to be scheduled on any suitable date in the fall of each year. The discussion lead by President Schommer was to have the annual banquet for the present 1929-30 year this spring, and if agreed to by the majority of the Alumni, hold the annual banquet for the year 1930-31 this coming fall. He pointed out also that by so doing we would be meeting the present requirement of two general banquets and a reunion during the year.

Nearly everyone present agreed to the suggested plan. It was suggested that to conform to the constitution and by-laws, the Secretary, Louis Hirsh, include in his letter announcing the coming spring banquet, a statement to the effect that the question will be put to a vote of the Alumni at the banquet.

Dr. C. W. Muehlberger Made Assistant at Crime Laboratory

Dr. Clarence W. Muehlberger, state toxicologist for Wisconsin and professor of toxicology in the state university at Madison, recently announced his resignation from both positions to become assistant director of Chicago's new scientific laboratory for the detection of crime, affiliated with Northwestern University.

Col. Calvin Goddard, ballistics expert, is director of the school at Northwestern. Dr. Muehlberger, in addition to assisting Col. Goddard, will also hold a post as professor of toxicology and pharmacology at Northwestern University. Since graduation from Armour Institute of Technology in 1920, he has served as assistant in research chemistry at Madison, studied under the late Prof. Victor Lenner, noted chemist; and the late Prof. A. S. Loevenhart, toxicologist and pharmacologist.

He was appointed Wisconsin state toxicologist in 1923, and since had engaged in innumerable investigations and testified often in poisoning and murder trials.

Thanks Friends for Letters

Recently the editor of the Armour Tech News was happily surprised to receive in his mail a letter from our beloved Dean Monin. It was written and mailed from Zurich, Switzerland. The letter follows:

To the Alumni, Faculty and Students of the Armour Institute of Technology.

Gentlemen:

Deeply regretting my inability of answering letters, postcards, and communications of all kinds from my friends across the ocean, I beg you to accept through the columns of the Armour Tech News my sincere thanks for your kindness and my grateful acknowledgment of your loyal friendship.

The greetings which I receive from U. S. are the joys of my days and the treasures of my heart. To you all my thanks, my sincere wishes for your welfare, and the season's hearty greetings.

As always, Cordially,

Louis C. Monin.

DEAN MONIN

Editor's note: The above picture was taken by Eugene Voita, '25, on October 23, 1929, in front of the Polytechnic Institute in Zurich.

Reo Motor Car Names Wilson General Manager

Very recently Richard H. Scott, president of Reo Motor Car Company, announced that William Robert Wilson, '06, had been elected general manager and a director of the company. Mr. Scott had been general manager as well as president and resigned the former position, remaining president.

Mr. Wilson's first connection with the motor industry was with Dodge Brothers. He later was with Chrysler Corporation and was receiver for Murray Body Corporation. He was formerly vice-president of Irving National Bank in New York. Later he organized the Guardian Trust Company and Guardian National Bank of Detroit. He has also been identified with the Allied Motor Industries, Henney Motors, Great Lakes Aircraft and Copeland Products.

Aurora Alumni Elects Vice-President

The Aurora-Armour Club held its annual election of officers on Dec. 21, at the home of its president, Mr. C. I. Carlson. It was originally planned to have a banquet, at the Turtle Rock Inn, located six miles south of Aurora, but due to the heavy snow storm making the roads all but impassible, the committee made the other arrangement.

The purpose of the club is to present engineering as a profession to young men and also to offer a means for the students and alumni, living in or near Aurora, to get together.

The officers elected at this meeting were, President, C. I. Carlson, '19; Vice-President, A. F. Wilde, '31; Secretary and Treasurer, R. A. Winser, '08.

Davies Develops Valuable Formula

Lynn E. Davies, '19, Assistant Professor of Experimental Engineering, attended a meeting of the American Society of Heating and Ventilating Engineers held at the Benjamin Franklin Hotel at Philadelphia, on Wednesday, January 29. Professor Davies presented his discoveries concerning ventilation under the title, "The Measurement of the Flow of Air Through Registers and Grilles."

All of Professor Davies work was done at Armour Institute during the past year and the results obtained were of such accuracy as to be adopted by the Chicago Ventilating Contractors' Employment Association as a standard. The adoption of Professor Davies formula has ironed out the controversy with the Board of Health, as it permits an accurate test of the ventilators.

The Amsco Bulletin Reports on B. S. Carr

Bradley Sayre Carr, '15

BRADLEY SAYRE CARR, Manager of the Pump Department, received his education in Chicago. In response to an early urge to become an engineer, he enrolled and was graduated in the first class completing the technical course in the Lane Technical High School. In order to complete his education, he took a teacher's training course at the Chicago Teachers' College, and after his graduation he became an instructor of mathematics and machine design at the Lane Technical High School. After some years he enrolled in the Mechanical Engineering Department of the Armour Institute of Technology, graduating in 1915, with the degree of Bachelor of Science and later receiving the degree of Mechanical Engineer from the same institution in 1924. He is a member of Tau Beta Pi, the honorary engineering fraternity.

After his graduation from Armour, he became chief mechanical engineer for the Grip Nut Company, manufacturers of railway supplies. From that position he joined the AMSCO organization, in 1917, where he has worked continuously since that time with the exception of the duration of the World War, when he served in the United States Tank Corps as an instructor in the Light and Heavy Tank Schools, with the rank of Lieutenant.

With the American Manganese Steel Company, his work has been in the broad field of excavation work, for which tools made of manganese steel are particularly well adapted. In the earlier years of his connection with the company, quarrying, earth stripping, mining, canal and ditch digging, all diversified forms of earth moving by means of steam shovels, drag lines, dipper dredges, the hydraulic pump dredges, claimed his attention. Seeing the possibilities that lay before hydraulic pump dredges in their proper application, he was soon giving all his time to the perfection and standardization of that type of excavation.

In 1921, he was made manager of the pump department. Upon him, in that position, devolved the work of the design, the manufacture, and the installation of manganese steel dredge pumps. Dredge pumps at that time seriously lacked practical standardization both of construction and materials used.

In the installation of dredge pumps, Mr. Carr has given much serious thought to field conditions and to the dredge, conceived as a complete working tool, wherein each auxiliary piece of equipment must conform and synchronize with every other part of the dredge.

He has worked on some of the outstanding hydraulic projects in the United States of recent years. For example, in the construction of dykes by the Miami Conservatory District, he consulted with the construction engineers in regard to the hydraulic fills. He made the hydraulic engineering analysis for the hydro-power Terminal and Diversion Dams built at Soft Maple, New York, by the U. G. I. Contracting Company. He supervised the engineering and dredge equipment details for the hydraulic fill behind the first section of the Gulfport Sea Wall on the Gulf of Mexico, that was built by Jahncke Service, Inc., in conjunction with Woods Brothers Construction Company. In addition, he has supervised numerous levee projects together with adjacent land development on the Mississippi River and its tributaries, canal construction, and harbor channel maintenance, as well as dredging requirements of numerous sand and gravel plant operators, producing commercial aggregates. After years of intensive study on hydraulic problems, he has earned recognition as one of the leading hydraulic dredge engineers.

PERSONALS

Fred Tayama, '30, is a radio dealer in San Francisco. He writes that he likes California and has no intentions of coming back east.

A letter was recently received from George Kloepfer, '29, telling of his experiences and courses down at the Naval Aviation Station, Pensacola, Fla. George is the only man who had his ground school training at Armour who mentally and physically was able to fulfill all of the requirements of the Naval Aviation Corps.

Sidney S. Pulaski, '29, was married to Wanda Janiszewski, a sister of Stephen Janiszewski, '30, on Saturday, January 25. The couple will make their home in Elkhart, Ind., where Sidney is employed in the capacity of electrical research engineer.

George G. Blair, '23, writes that he is planning to re-enter business life, resigning from the Army Air Corps. George is at present stationed at March Field, Riverside, California, as a student. He is going with Johnson and Higgins, brokers, New York City. George was a star sprint man on the track team in '22 and '23.

Raymond F. Stellar, '29, advises us that he has changed positions. He is now in the U. S. Engineer's office, Room 1325, at 333 N. Michigan Avenue.

Robert P. Burns, '24, has left Warner Brothers and is now business supervisor of projection for the Publix Theatres with office at 408 N. Ashland Avenue.

C. M. Nelson, '26, returned to school Thursday for a short visit with the Civil Department. Nelson is now on the editorial staff of the Gillette Publishing Company, publishers of "Engineering and Contracting" and several other engineering periodicals.

Former Student Killed in Plane

It is with deep regret, that Armour learned of the death of Ensign John D. Clark, a former student, on Thursday, January 7. He was killed, when the Loening 2-place amphibian, powered with a 450 H. P. engine, in which he was flying, fell 1500 feet into San Diego Bay and was completely demolished.

Ensign Clark was accompanying Lieutenant Eugene F. Burkett, U. S. N. on a trip to Otay Mesa to be checked on ability to make carrier landings before the cruise of the fleet. The team was composed of the amphibian flown by Lieutenant Burkett and Ensign Clark and another sea-going plane piloted by Ensign Nelson.

When Lieutenant Burkett and Ensign Clark failed to appear at the appointed time in Otay Mesa, Ensign Nelson flew back over the San Diego Bay region in search of them. He located the other plane flying in unnatural circles over San Diego Bay. Due to the fact that both planes were to report immediately after carrying out their instructions, the antics of the fatal plane seemed to indicate that it was in distress. After a long glide that ended in a spiral, the plane fell into a spin from which it never recovered.

Lieutenant Burkett had just completed the third Alaskan Aerial Survey and knew Loening amphibians thoroughly. Overconfidence of the pilot in his ability to bring the plane out of the spin is probably the reason for their not jumping.

Mr. E. M. Pinkerton, of the class of 1909, has been manager of the Minneapolis office of the General Electric since last September. He was made acting manager of that office in December, 1928.

Mr. Pinkerton was born in Hanna City, Illinois, graduated from Armour Institute of Technology with the degree of B. S. in E. E. in 1909 and entered the Testing Department of the General Electric Company in Schenectady in October of that year.

In December, 1910, he became a student salesman at the General Office, Schenectady, and in March of the following year was transferred to the Central Station Department, Chicago, as a salesman. In July, 1912, he went to the Minneapolis office, where he was engaged in general sales work, and from October, 1917, to June, 1919, he was in military service. On completion of his army service, he returned to the Minneapolis office, and, as stated, was made acting manager in December, 1928.

Fred Payne, '28, dropped us a line from Milwaukee, Wisconsin, where he is busily engaged by the Wisconsin Inspection Bureau. Fred's old record for the two mile run still stands at Armour, if we are not mistaken. A few years ago, Fred used to set a new record for a distance run, then Phil Deiwert, '28, would come along and break it. The next meet, the process would be continued. Now all records from one-half mile up stand in the name of these two men. Deiwert, by the way, is with the Indiana Inspection Bureau at Indianapolis.

Speaking of track men, Johnny Yount, '29, dropped around the other day to say hello. Johnny used to be one of our star shot-putters.

Alumnus Writes for American Architect

"An Easy Way to Specify Lumber" is the title of an article published in the January number of the American Architect, one of the leading architectural magazines, by Dudley F. Holtman, '15. Mr. Holtman, who until recently was construction engineer of the National Committee on Wood Utilization of the United States Department of Commerce, has had a leading part in the work of standardizing lumber specifications in the United States.

So he died for his faith. That is fine.
More than most of us do.
But, say, can you add to that line
That he lived for it, too?
In his death he bore witness at last
As a martyr to the truth.
Did his life do the same in the past,
From the days of his youth?
It is easy to die. Men have died
For a wish or a whim—
From bravado or passion or pride,
Was it harder for him?
But to live—every day to live out
All the truth that he dreamt,
While his friends met his conduct with doubt
And the world with contempt.
Was it thus that he plodded ahead,
Never turning aside?
Then we'll talk of the life that he lived.
Never mind how he died.
—"Life and Death," by
Ernest Crosby.

We had the pleasure of an extended visit with Gordon Wilson, '04, the other day in his office suite at 327 S. La Salle Street. He is Director of Safety for Utilities Power & Light Corporation. Incidentally we left his office with a copy of The Society of Industrial Engineers Bulletin for February in which the leading article "Training of Junior Executives" was written by Gordon Wilson.

E. B. Fogelsong, '14, is a sales engineer with the Louis Allis Company of Milwaukee, Wisconsin. He works out at the Chicago office, 332 So. Michigan Avenue.

The February luncheon brought out Eugene F. Hiller, '06. He is now with the Union Central Life Insurance Company located on the twenty-third floor of the Bankers Building, 105 W. Adams Street.

One of the recent products of Armour Tech made himself known at the February luncheon. John J. Brady, '29, represents Sundh Controlling Devices and offices at 33 N. Michigan Avenue.

T. J. Kiene, '15, has changed his address in Texas, but remained loyal to Amarillo. He is assistant engineer for the Atchison, Topeka and Santa Fe Railroad and lives on Route 3, Box 294, Amarillo, Texas.

Walter Healey, '29, visited school Thursday. He is now engaged in building construction for the Stoltz Construction Company of Chicago.

Richardson, '24, Verifies Theory by Experiments

At a meeting of the American Physical Society which was in session with the American Association for the Advancement of Science and Associated Societies, held in Des Moines, Iowa on December 31, D. E. Richardson, instructor in the Electrical Engineering Department, gave a paper on "Resistance of an electrolytic conductor at various frequencies." The paper was a summary of Professor Richardson's thesis on "Experimental Verification of the Theoretical Skin-effect Equation, for an Electrolytic Conductor" which he prepared for his M. S. degree at the University of Chicago.

C. M. Schneider, '27, has been transferred from Madison, Wisconsin, to Milwaukee. He is also working with the Wisconsin Inspection Bureau and at the present time is living with F. D. Payne.

H. A. Koge, '28, has also been transferred from Eau Claire to Milwaukee, where he has joined his former classmates.

W. T. Watt, '17, who was formerly an instructor in electricity at Lane Technical High School, Chicago, is now connected with the Chicago Branch of the Fairbanks-Morse Company.

G. H. Van Gehr, '28, is dividing his time between his work in the patent office and going to school.

J. W. Kent, '27, is with the Missouri Inspection Bureau. Last Saturday he flew to the Sigma Kappa Delta Banquet from St. Louis.

P. S. Deiwert, '28, is recuperating in a hospital in Indianapolis, Indiana. He will be ready for work in a short time according to the latest news.

Sheldon H. Webster, '21, writes us about a change he has recently made. He left Armour & Company after several years spent in the different plants, to take a position with the Haynes Corporation, 1545 First National Bank Building, Chicago, Illinois. Because his work is in Wisconsin he has forsaken Berwyn, Ill., for Eau Claire, Wisconsin. He lives at 228 Huron Street in that city.

Several companies serving the Chicago District have sent representatives to the Institute to interest the members of the Senior Class in the advantages their companies have to offer. Milwaukee Electric Crane & Hoist Corporation sent Elmer B. Kapke, '28, and Illinois Bell Telephone sent L. H. Bernhard, '29, as their representatives this year.

Mortimer D. Beck, '25, just recently changed positions. For the past few years he has been with Mechanical Rubber Company in different capacities in the laboratory and plant. He is now a salesman-chemist with the Commerce Petroleum Company at 2619 Lock Street, Chicago. There is a rumor afloat to the effect that since he has made this change he may make another, namely—desert the ranks of blessed bachelordom. We wish him luck in one or both moves.

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Make The Armour Engineer the best technical college publication in the country.

> *Ideals are like stars; you will not succeed in touching them with your hands, but like the seafaring man on the desert of waters, you choose them as your guides, and, following them, you reach your destiny.*
>
> —*Carl Schurz.*

A MANAGER in Brussels recently telegraphed a weaving mill in Roumania telling them of a cracked bolt in the coupling of which they were unaware. How was it possible for a man almost 2,000 miles distant to become aware of trouble and to definitely locate it, when men in direct contact with the work, men personally in charge, were ignorant of the presence of any trouble? Clear, logical thinking on the part of the distant manager and a complete set of reports from the mill were responsible.

A seven per cent drop in the output of the mill caused the manager to look for a plausible reason. The explanation forthcoming was that inexperienced help had been taken on and work proceeded more slowly. This report was investigated and it was found that all of the departments, some of which had not taken on new men suffered the same drop which proved definitely that something was wrong. The only factor which could affect all of the departments in the same proportion was the speed of the looms, and tachometric reports showed the motor speed to be normal. Between the motor and the looms, a coupling connected the shafts. Two bolts held the coupling together, if both broke, the plant would stop, if one gave way, the coupling would slip. Evidently one of the bolts had broken.

An incident such as this brings to us an insight in the possibilities of management from a distance. Perhaps more important it illustrates the method of analyzation of problems and the clean cut method by which the conclusion is arrived at. Every step is positive, every conclusion is justified. It is exactly similar to a method used in geometry to prove certain theorems. There are a number of possibilities; if all but one are proved untrue, the remaining must be true. Every possible explanation but one is investigated and found wanting, the remaining possibility must be the solution.

PROBLEMS, to the student of engineering, are no innovation. Half of the time he spends on outside work is in their solution. Seniors in all of the departments are at the present time facing a problem, to most of them, the most difficult as well as the most important that they have ever been concerned with. This is the problem of employment. All of the time spent in school has been in preparation for a professional career; now that their preliminary training has been completed, the question of how and with whom to get started presents itself. Should he leave town, what are the future possibilities, do starting salaries mean anything, will the type of work appeal, is the field overcrowded, are some of the many questions that arise in the mind of the average senior.

The advantages and the disadvantages of work with the different companies must be carefully tabulated. All of the reducible data must first be considered: the starting salary, and the cost of living if the position is out of town. A little more difficult is totaling the irreducible data: the future prospects, personal preferences and tastes, new living conditions, and other innumerable details. Comparisons of the opportunities offered by different places should be made and a decision come to as soon as possible.

A good start may mean a saving of years in getting permanently located. If we could choose our jobs, the start would be easier, but as it is we must wait and be chosen. Representatives of the various firms judge a man by his scholastic record, his activity record, the recommendation of the professor, and their personal judgment of his character. It would be well for underclassmen to keep this in mind so that when their time comes, they can step forward confidently, backed by a record of which they can be proud.

THE INAUGURATION of a campaign against fraudulent technical, trade, and correspondence schools has been recently announced by the American Association of Engineers. This action is to be commended.

The short history of the mail order universities is an infamous one; a tale of extortion and pitiless deception. Popular magazines serve to carry enticing but quite misleading advertisements into fertile fields, the rural sections of the country. These, followed by high pressure salesmanship and a total disregard for truth, result in an astonishing number of enrollments every year.

The facts disclosed by the Association are tragic. The correspondence school industry is doing an annual volume of business estimated at $85,000,000. There are 2,000,000 students enrolled, four times as many as in all colleges, professional schools, and universities in this country. Shortly after beginning the course, most of the individuals realize that they have been swindled into signing a binding contract and, while they all pay for it, less than two per cent complete their "education." Those who receive their diplomas certifying that they are electrical engineers or qualified playwrights are turned loose to find their ten thousand dollar jobs. They always meet with a frigid reception in the big city where they come to don white collars. The disillusioned graduate is generally in no position to spend much time looking for his berth. Destitution follows and the charitable institutions are called upon for aid. With startling regularity, this path is trod by those unfortunates who only in rare instances have seen the inside of a high school. Some of them have even a Doctor of Philosophy degree, conferred for eight dollars and fifty cents, cash in advance!

Such treatment is certainly not humane. To build up high hopes in the minds of these earnest but misguided men, only to have them crash to earth is more cruel than the theft of their money. Robbery and disillusion together is heartless treatment.

The college-trained engineer is affected in no small measure by these fake technical schools. Some employers receive an unfavorable impression of educational standards in the engineering profession as a result of interviews with products of diploma mills and, while for the most part there is better understanding of matters, there is a tendency to class all "technical schools" in one category. The effect is damaging.

Only by strong, persistently aggressive action can the situation be remedied. The public must be made aware of facts such as have been outlined. In its aim to manage the campaign, the American Association of Engineers is performing noteworthy duty. We should cooperate.

SOMETIME in a student's college days, he comes across some man who embodies characteristics which to the student are ideals. Since the average college student is past the age of hero-worship, he looks to this man with the respect and admiration that the pupil pays to the master. The student admires the manner in which this man performs his work and the way he solves his problems, he enjoys watching the man in his contacts with men above or below his station, and he is amazed by his ease, and his air of confidence.

To the wide awake, self-conscious student, such a man can be of inestimable value. There are comparatively few people who really are acquainted with themselves; who know just what kind of a person they are, their characteristics, their habits. At the end of a day's work, the student should set aside about five minutes in which to get "next to himself" and to review the outstanding things that had happened that day. Ask himself how this admired man of his would have decided a question that came up that day, how that man would have acted under the circumstances, and compare them with his own decision and action. Would he have had a different answer or have acted differently had he time in which to think it over?

SEA FEVER

I must go down to the seas again, to the lonely sea and the sky,
And all I ask is a tall ship and a star to steer her by;
And the wheel's kick and the wind's song and the white sail's shaking,
And a gray mist on the sea's face and a gray dawn breaking.

I must go down to the seas again, for the call of the running tide
Is a wild call and a clear call that may not be denied;
And all I ask is a windy day with the white clouds flying,
And the flying spray and the blown spume, and the sea-gulls crying.

I must go down to the seas again, to the vagrant gypsy life,
To the gull's way and the whale's way where the wind's like a whetted knife,
And all I ask is a merry yarn from a laughing fellow-rover,
And quiet sleep and a sweet dream when the long trick's over.

—*John Masefield.*

The student by constantly comparing his actions with those of this man, who is usually older and more experienced, gradually acquires those qualities which he so much admired and respected. If any of the problems or situations should reoccur, he is now prepared to give them the full benefit of his judgment, since he has already thought about them; he does not have to offer snap judgment, which may not be what he would have decided had he had the time in which to think it over. Not only may these personal conferences be applied to problems of the past, but also to those of the future. If by spending these few minutes in reflection and contemplation, the student is able to think and work more clearly and definitely, he has found a valuable critic and the admired man has unknowingly proved a guiding light.

ENTHUSIASM is the greatest asset in the world. It beats money and power and influence. Single-handed the enthusiast convinces and dominates where the wealth accumulated by a small army of workers would scarcely raise a tremor of interest. Enthusiasm tramples over prejudice and opposition, spurns inaction, storms the citadel of its object, and like an avalanche engulfs all obstacles. It is nothing more or less than faith in action. Faith and initiative rightly combined remove mountainous barriers and achieve the unheard of and miraculous.

Set the germ of enthusiasm afloat in your plant, in your office, or on your farm; carry it in your attitude and manner; it spreads like contagion and influences every fibre of your industry before you realize it; it means increase in production and decrease in costs; it means joy, and pleasure, and satisfaction to your workers; it means life, real, virile; it means spontaneous bedrock results—the vital things that pay dividends.—Henry Chester.

FOUR MARKS OF A FINE MIND

By Glenn Frank, President of the University of Wisconsin

A good mechanic studies the tools of his trade continuously and critically. The better he knows his tools, the better he can use them. He knows that good craftsmanship is impossible unless he keeps his tools adjusted to his tasks.

Our brain is, of course, the major tool we bring to the task of living. Like good mechanics, we profit from keeping our brains under continuous and critical study. As a sort of primer to guide us in such a study of our own minds, I suggest that a first-class mind bears these four marks:

First, *humility*. A first-class mind is never cocksure; it is always willing to admit that it may be wrong; it is never afraid to say that it does not know; it does not specialize in closed questions; all questions are open questions to it; it is always ready, in the presence of new knowledge or fresh challenges, to question the soundness of its earlier observations and the sanity of its earlier conclusions.

Second, *curiosity*. A first-class mind is never satisfied with surface observations; when, in its humility, it has admitted that there is a question to be considered, it turns a restless and ruthless curiosity on the question; it is never satisfied with a sweeping judgment; it ferrets out every detail and tries to see just what bearing such detail has on the whole question.

Third, *courage*. A first-class mind is marked by a subtle blending of courage and imagination, the result of which is that it takes the results of its analysis of a problem it has worked over and puts these results into various new combinations in an effort to find some new and better theory for action; it is willing to follow a new idea, even if it upsets former notions and former ways of doing things.

Fourth, *responsibility*. A first-class mind has a sense of responsibility in handling its new theories; it puts them through all sorts of tests to prove both their logical soundness and their practical utility.

The practical fruits of the intellectual virtues are obvious; Humility makes for open-mindedness. Curiosity makes for careful analysis. Courage makes for creativeness in blazing new trails. Responsibility makes for reliability in action.

College Notes

Tau Beta Pi

The Armour branch of the engineering honorary fraternity held an initiation banquet at Coffee Dan's on the evening of January 22, 1930. At that time nine men who have stood high in scholarship and school activities were presented with the Tau Beta Pi key.

It has always been the custom for Tau Beta Pi to donate a handbook to the freshmen having the highest average during his first year at Armour. This year a copy of the Chemistry and Physics Handbook was presented by Pres. H. M. Raymond at the winter concert assembly to Jack Cavanaugh, Chem. '32. The purpose of this award is to stimulate interest in high scholarship among the newcomers at the Institute.

Eta Kappa Nu

The members of Eta Kappa Nu, the electrical honorary fraternity, are in the midst of spring house cleaning. Drigot and Patzelt with the help of other members have done a good job of papering the rooms and calcimining the ceiling, so that the rooms look a hundred per cent better. L. F. Bernhard, a member of HKN, and editor of the Armour Engineer last year was back at the Institute on March 12 to arrange for interviews concerning employment with the Illinois Bell Telephone Co. Jack Dollenmaier, chairman of the Armour branch of the A. I. E. E., and other members of HKN took an active part in the A. I. E. E., Smoker.

Pi Tau Sigma

Delta Chapter of Pi Tau Sigma elected for its officers of the spring semester of 1930 the following men:

Pres.—H. W. Faulstich, '30
Vice-Pres.—R. B. Johnston, '30
Corres.-Sec.—C. T. Link, '31
Rec.Sec.—F. F. Strassenberg, '31
Treas.—C. F. Vojtech, '30

Continuing the custom, at the winter concert this chapter awarded to the highest freshman in the mechanical engineering department a copy of Kent's Handbook. The recipient was Harold B. Davis, '32. The purpose of this award is to stimulate interest in high scholarship among the newcomers in this department at the Institute.

Chi Epsilon

On the evening of January 29 at a banquet held at the Phi Kappa Sigma house, the following men were initiated into the Armour Chapter of Chi Epsilon:

Prof. H. T. Heald
George W. Kohout, '30
Morris O. Nelson, '30
Russel A. West, '30

The entire group, including faculty, alumni and actives, attended the theater after the banquet.

The men elected to office for the spring semester 1930 are as follows:

Pres.—John P. Edstrand, Jr.
Vice-Pres.—John W. Hurley.
Sec.—Leon H. Fischman.
Treas.—Russel A. West.

OUR VARSITY CAPTAINS

Swimming

Fred Strauch, Arch. '30

The swimming team at Armour does not receive perhaps as much credit for the part it plays in the school athletics as it deserves. Being a minor sport and one that is not very spectacular from a spectator's standpoint, its activities go on unnoticed by the majority of the student body.

The swimming team this year, however, under the leadership of Fred Strauch, has been a credit to the school. Fred was born in Chicago on July 4, 1908. He obtained his prep school training at Lane Technical High School. His swimming ability was recognized while at Lane, and he was made a member of the swimming team there. He was also interested in gymnastics at that time and won his letter for his ability along that line.

On coming to Armour, Strauch became interested in boxing as well as swimming and was on the boxing team, winning a letter in this sport. From the first he was a consistent point winner on the swimming team, competing in almost all events, including free style, breast stroke, and diving. His specialty, however, is diving. He holds the A. A. F. championship in this event, and is the champion fancy diver of the Lincoln Turnverein organization. He is always sure of winning his event in any of the Armour meets.

Strauch is captain of what is probably the best swimming team Armour has ever had. The members are all able, conscientious swimmers and turn out in full force for every meet. They made a creditable showing in their first meet against South Chicago "Y" who have since become city and state champions with a possibility of becoming national champions. Armour has won decisive victories in all other meets this year and have every reason to believe that they will continue to do so.

Besides his athletic activities, Strauch is well up in his scholastic standing and in his drawing of plans would no doubt like to include a swimming pool in every home.

A. I. E. E.

During the past few weeks, the Armour Branch of the American Institute of Electrical Engineers has had the opportunity of listening to a few good speakers on subjects of varied interests.

On January 10, Mr. K. R. Ross, of the General Electric Co., spoke on the Chicago Civic Opera Stage Lighting Control.

Mr. Maiers, of the Commonwealth Edison Co., presented an interesting talk, January 24, with illustrated slides on "Know Illinois."

"Modern Telegraphy—A New Art With an Old Name," was the topic of the lecture given February 18, by Mr. John H. Bell, of the Bell Telephone Laboratories.

A business meeting was held February 28, at which many new policies were presented and discussed. Announcement of the Smoker was made.

The annual Spring Smoker was held at the Theta Xi House, Wednesday evening, March 12. The reputation of this smoker was not foreshadowed by that of previous affairs. Electricals from the sophomore, junior, and senior classes were present as well as the electrical faculty and a large number of alumni. There were plenty of refreshments and the efforts of the entertainment committee were especially appreciated following the presentation of a short skit written by one of the committee members.

Armour Tech Rifle Club

The rifle club has been busily engaged in constructing a new range in the basement of Chapin Hall. Through the efforts of R. A. Hess, enough steel was obtained to act as "back stop." Prof. Peebles obtained from Mr. Bracken of the Celotex Company enough of their product to form a background in front of the steel plating. A very good lighting system was installed by the school electrician and all range lights are controlled from a switch located at the firing point.

This range was found advisable because of the short time to be had for practice, too much time being spent in travelling to the Armory Range. It now takes only a few minutes to get started. The club is, however, much indebted to the Officers at the Armory for the use of their range.

The financial standing of the club is such that in the near future more rifles can be bought as well as other needed range equipment which although not essential makes it easier to conduct the firing and increases the pleasure of the individual men using the range.

Swimmers Win Five in Row

Armour's swimming team has thus far enjoyed a more successful season than any other team in the school. To date, the tankmen have a record of five wins to one loss. The single defeat was handed them by the South Chicago Y. M. C. A. swimmers, state champions. That meet, incidentally, was the first that Armour had this season, and Armour's relative weakness was attributed to their lack of practice. Although the team was rather loosely organized in this meet, South Chicago was only able to edge out a 30-23 victory.

Following the South Chicago meet, Armour met the Englewood Y. M. C. A., Hyde Park Y. M. C. A., Chicago Normal College twice, and Crane College. Victory was attained on every occasion.

The two meets with Chicago Normal College were won by very decisive margins. The first meet, held on February 21, was won 47-13, and the second meet, a week later, was won 56-8. Armour made a grand slam of first and second places in every event to win the meet.

Armour's most closely contested meet was experienced on March 12, against the reputed Crane College swimmers. Armour edged out a 39-36 win.

Much of the team's success is attributed to the excellent performances of Captain Fred Strauch, Trognitz, Weston, Carlstrom, Knox, Cavanaugh, Byanskas, LaForce, and Davison.

The fancy diving events have always been clinched by Armour when Fred Strauch entered into the contest. Walter Trognitz has featured in the breast stroke events. He holds the all time Armour record in the 200 and 100 yard swims.

Both Strauch and Trognitz are graduating this year. The other members, however, will enter into competition next season.

The record for the back stroke swim in distances of 60 and 150 yards and for the free style swim, 220 yard distance, was established this year by Weston. Weston has proved to be an important factor in Armour's success this season.

Carlstrom, Knox and Cavanaugh have also contributed their share of first and second places in the meets. Carlstrom fancies the 100 yard free style, while Knox and Cavanaugh have been leaders in the 40 yard breast stroke. Byanskas has always placed first in the 40 yard free style. LaForce and Davison were important competitors in the 220 yard free style.

The following are the all time Armour records for the various events.

Event	Yards	Time	
Breast Stroke....	200	2:46 2-5	Trognitz
Breast Stroke....	100	1:14	Trognitz
Back Stroke.....	60	0:42 4-5	Weston
Back Stroke.....	150	2:07	Weston
Free Style.......	40	0:19 4-5	Dithmer '28
Free Style.......	100	0:57	Dithmer
Free Style.......	220	2:51	Weston

160 yard Relay Time 1:23—Carlstrom, LaForce, Byanskas, Knox.

Medley Relay—Weston, Trognitz, Knox.

Armour Closes Basketball Season

Armour's basketball team closed its 1930 season on February 27, losing the final game to Michigan State Teachers College at Ypsilanti. The game was played at the Armory located at 35th and Giles Sts.

Armour took action in fifteen games this season, and won but five games. The initial game was played with the Alumni. Armour won the game 37-17. The team then lost its second game to Y. M. C. A. College 25-18, but retaliated in the following week by winning three games in succession. Wheaton College, Chicago Normal and the McKinlock Campus quintet of Northwestern University suffered defeat.

Basketball Squad, 1930.

Rear—Pepe, Faulstich—Manager, Bruni, Tell, Sanstedt, O'Connor, Rowley, Kraft—Coach, Lind.

Front—Rossing, Rutkowski, Robin, Simpson—Captain, Mirian, Ott.

After winning the three games, Armour lost to Augustana, but the team broke into the winning column again when they defeated the Northwestern team for the second time. Up until this time Armour had a record of five victories and two defeats. Since the season was about half over, all indications pointed to a very successful season. The team was only obliged to win half of the remaining games if they sought to make it a banner season.

The victory over Northwestern, however, was the last that Armour enjoyed in the 1930 campaign. Eight more games remained on the schedule but all were lost. Chicago Normal College, DeKalb Teachers, Augustana, Michigan State Teachers and St. Mary's College of Orchard Lake, Michigan, provided the opposition in the eight games.

It appeared that fate destined Armour to lose. At times the team would start a game with a bang-up of basketball. They would acquire a good lead and make things appear as though the day was won. Yet, regardless of how impressive they made the going in the first period, they would sooner or later ease up and find themselves trailing when the game ended. Several of the games were lost by one and two point margins. Two of the games were extended to an overtime period, but the outcome of these eight games was always the same—Armour lost.

The work of Captain Simpson was highly commendable. Simpson led the team in scoring and played an excellent offensive game throughout the season.

Rossing, Ott and Rowley were Armour's aggressive forwards. Their performances were of the type that should have converted many of the defeats into wins. Tell and Robin handled the pivot position. Robin excelled in his accurate passing, while Tell fought a stellar defensive game.

Rutkowski, Miran and Bruni, formed the team's staff of hard fighting guards. From time to time Coach Krafft placed Sanstedt, Pepe, O'Connor, Stabovitz and Lind in the line-up.

Boxing Team Ends Successful Season

The 1929-30 season has been the most successful in the history of the boxing team. This year more men have reported for practice, more meets have been held, and the results have been more optimistic than ever before. The feature event of the season was the second South Chicago Y. M. C. A. meet which was held at the school, an undertaking that has never before been attempted.

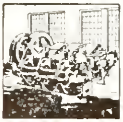
Practice started early last semester and under the skilled guidance of the new coach, "Sonny Weissman," the team was rapidly brought into condition. The first meet of the season was against the Lincoln-Belmont Y. M. C. A. at their gym, on Jan. 25. The result of the meet was a tie, Armour winning three of the bouts and the opponents taking the other three. Capt. Buehling, Ustriski, and Donnelly winning their bouts and Taylor, Montesano, and Sommers succumbing to the "Y" men.

South Chicago Y. M. C. A. next engaged the attention of the Armour pugilists on Feb. 15. The state championship "Y" team, however, proved too clever for our boys and all of the matches were lost. The score does not indicate the true state of affairs, for all of the fights were good. The men who fought were Captain Buehling, Schlossberg, Whitfield, Montesano, Ustriski, and Morowitz.

The return match with the South Chicago "Y" showed the improvement in the shape of the battlers. A crowd of 200 students witnessed the fights and Armour succeeded in taking the match by the score of 3-2. The men who came out on the top were Ustriski, Schwartz, and Whitfield. The other two men who fought were Montesano and Morowitz.

The next team to fall before the Armour men was the West Side Professional Y. M. C. A. and the score was 3-2. Quite a few Armour men were present to watch the fights although the meet was held at the "Y". The men who fought were Captain Buehling, Larkin, Schwartz, Montesano, and Donnelly.

With the Culver match, the season will come to a close. Previously boxing had not attracted much attention at school, but with the scheduling of home meets, new interest has been aroused in the sport. Next year will probably show a still greater turnout for the team and a more successful season.



ENGINEERING NEWS

Denaturing Auto-Exhaust Poison Gas

For years people have contended with the deadly exhaust fumes from the automobile, but in the near future, due to remarkable work by Dr. J. C. W. Frazer of Johns Hopkins, the menace will be removed. Professor Frazer's device, which will take the place of the usual muffler, acts simply by feeding more oxygen to the carbon monoxide exhaust, converting it into the harmless carbon dioxide gas. Because of patent claims, the exact nature of the material which affects this change has not been revealed, but it is known to be a catalyst. It is similar in action to the catalyst consisting of manganese dioxide and copper oxide which Dr Frazer developed during the World War for gas masks and is now being used by fire departments and mine rescue squads for purifying the air of carbon monoxide.

The invention has proven entirely satisfactory during exhaustive tests and will be placed on the market when it has been further simplified and made entirely automatic. As evidence of its thorough action, a car equipped with this purifying muffler can be operated in a closed garage without danger from carbon monoxide poisoning.

The Gyroscope in the Airplane

Gyroscopes have long been used to pilot huge liners across the seven seas, but it was not until recently that one successfully completed the difficult task of guiding an airplane. Developments along this line were started in 1914 but commercial application was detained until the present machine was perfected. The device weighs a mere fifty pounds and consists essentially of one vertical and one horizontal gyroscope so designed that any tipping, diving, or turning of the plane immediately effects the revolving wheels and actuates the rudder or elevator accordingly through the medium of an electric magnet. The pilot can thus be relieved of a large amount of strain, especially on long flights, and his efficiency is correspondingly increased. Successful navigation in fog, sleet, snow, and rain is assured, and nothing except atmospheric drift can draw the plane from its set course when the gyroscope control is in operation.

Improved Transmitter for New KDKA Station

Westinghouse station KDKA will have its new transmitter near Saxonburg, Pa., an antenna which is expected to overcome one of the major obstacles of high power broadcasting. This antenna, it is announced, will not send a "blanketing" signal over the surrounding territory, yet it will send out a powerful one to distant points.

In this way receiving sets near the station can tune in distant programs despite the fact that they are within short range of an antenna which is radiating strong signals. The new antenna is of special benefit to cleared channel stations which are intended to serve a huge area as well as a local territory.

Experimental antenna at Saxonburg, Pa. This aerial sends out a strong sky wave with a minimum ground wave.

By reversing the action of the antenna it will be possible to send out a strong ground wave and a weak sky wave, which is a condition valuable to the local station. By decreasing the sky wave of the weaker station its "nuisance" area will be cut down as it will not cause as much interference at a distance.

According to Walter C. Evans, Westinghouse superintendent of radio operations, the new antenna is being developed by Dr. Frank Conrad, assistant chief engineer. During the past year a great deal of theoretical and experimental work has been carried on in the development.

Gas Firing a Locomotive

A saving of $24,000 yearly is now being made by the Southern Pacific Railroad Company by the use of natural gas for firing the locomotives in getting up steam. As far as is known, this has never before been attempted.

After a run, a locomotive is placed in the roundhouse, thoroughly inspected, and prepared for its next trip. Previously, steam had to be taken from the boiler plant to break up the oil before the engine could be fired. With the use of gas, however, all that needs to be done is to attach a gas line from the shop mains to the oil burner, apply a torch, and the fire is ready. The gas flows through the regular oil burner, and uses it as a gas burner.

The gas fire provides a means of gradual heating of the engine which could not be had under the old system of firing, thus bringing up steam at any desired time. This is very much easier on the engine itself and its mechanical equipment.

Some of the other advantages of using gas for this process are: the engines can be fired in much less time than formerly; the smoke nuisance is avoided; the fire hazard from oil drippings is done away with; and finally, there is a financial saving of more than $24,000 a year.

The Los Angeles roundhouse will hold 60 engines at one time. Approximately 10,000 cubic feet of gas an hour is used to get up steam for one engine, and often from four to six engines are fired in an hour.

Extremes in Density

Substantial evidence, obtained by prominent physicists and astronomers, has proven the existence of matter whose density ranges from three-millionths to four hundred thousand times that of water. Almost a million gallons of the lighter substance would weigh as much as a quart of water, and a cubic inch of the latter would balance a load of seven tons. Such figures seem absurd but new discoveries in astronomical physics have removed practically all doubt. A general relation between the absolute magnitude of the star and its mass,—the greater the luminosity the greater the mass, —has fixed for one star in particular, one discovered by Dr. Adrian van Maanen of Mount Wilson Observatory, California, the mass of one-tenth that of the sun. Having measured its size to be even smaller than the earth, its mean density was calculated to be 400,000 times that of water. The mean specific gravity of the earth is 5.5 and that of the sun is 1.4.

In a quite different way it was proved several years ago by Dr. Adams that another very small star, the companion of Sirius, had a density about 50,000 times that of water. The direct contrast to van Maanen's star is Antares whose density was found a few years ago by Dr. Pease to be one three-millionth that of water. The enormously higher densities assigned to the electrons and the proton of an atom, place the above figures well within the bounds of reason, and this scant bit of information should not be regarded as a scientific joke but as the introduction of an enormous store of facts which lie undiscovered.

Iceless Refrigeration Cars

The perfection of a mechanical refrigeration plant for railroad cars in the transportation of perishable foods from far removed localities to the large consuming centers has been a much needed solution to perishable transportation and is an improvement in keeping our vitamines in the proper condition.

The automatic iceless refrigerator car is operated from the axle of the car as it is in transit. The medium used for the reduction of temperature is ammonia and brine as is used in the more common small refrigerator plants. The car is equipped for temperature control and can be set and left to maintain an even temperature as long as the car is moving. When the car stops the motor stops, but the car will maintain its previous temperature for 72 hours. If it is desirable to keep the motor running, it has an electric motor than can be operated by plugging into an electric switch.

Some of the advantages are: the new car is lighter in weight, there is no stopping for ice, which will save switching charges and labor bills of the train crews. Salt and brine used in the old cars has always done much damage to railroad property, but this is eliminated in the new car.

An Electrical Help

From the wheels of modern progress in this era of speed another application of electricity has been evolved. It is a method which has been devised by agronomists at the University of Wisconsin for the testing of plant winter hardiness.

Science and the research engineer have found an application of their discovery in agriculture. These two factors are very important in aiding the farmers' situation in the present and future. Many important discoveries in the past have relieved the agriculturist of many of his waste products. The future will reveal many more secrets for the betterment of the present situation.

The streets are full of human toys,
Wound up for threescore years;
Their springs are hungers, hopes and joys,
And jealousies and fears.

They move their eyes, their lips, their hands
They are marvellously dressed;
And here my body stirs or stands,
A plaything like the rest.

The toys are played with till they fall,
Worn out and thrown away.
Why were they ever made at all!
Who sits to watch the play!

"*Playthings,*" *by R. L. Stevenson.*

The discovery is much simpler than it sounds. It is a test on alfalfa, in which the roots of the plants are placed in a test tube. The roots are first frozen and then thawed. Distilled water is added and the roots are soaked for ten hours. At the end of this period the solution is tested to see how readily it conducts electrical current.

It was found that an inverse ratio existed between the current flowing and the plant hardiness; that is, as the ability of the solution to conduct current decreases the hardiness of the plant increases.

This method is very efficient because cells of resistant plants do not lose their cell contents readily when soaked in water. If the plants are not very resistant, freezing causes the injured roots to empty their contents into the water. The number of injured cells thereby determine the degree electrolyte obtained.

This method checks results with field trials to a very high degree of accuracy. The time saving more than pays for the experiment; the former taking but eighteen hours and the latter four to five months. Further developments with the new test are expected with other crops.

A Unique Sound Reflector

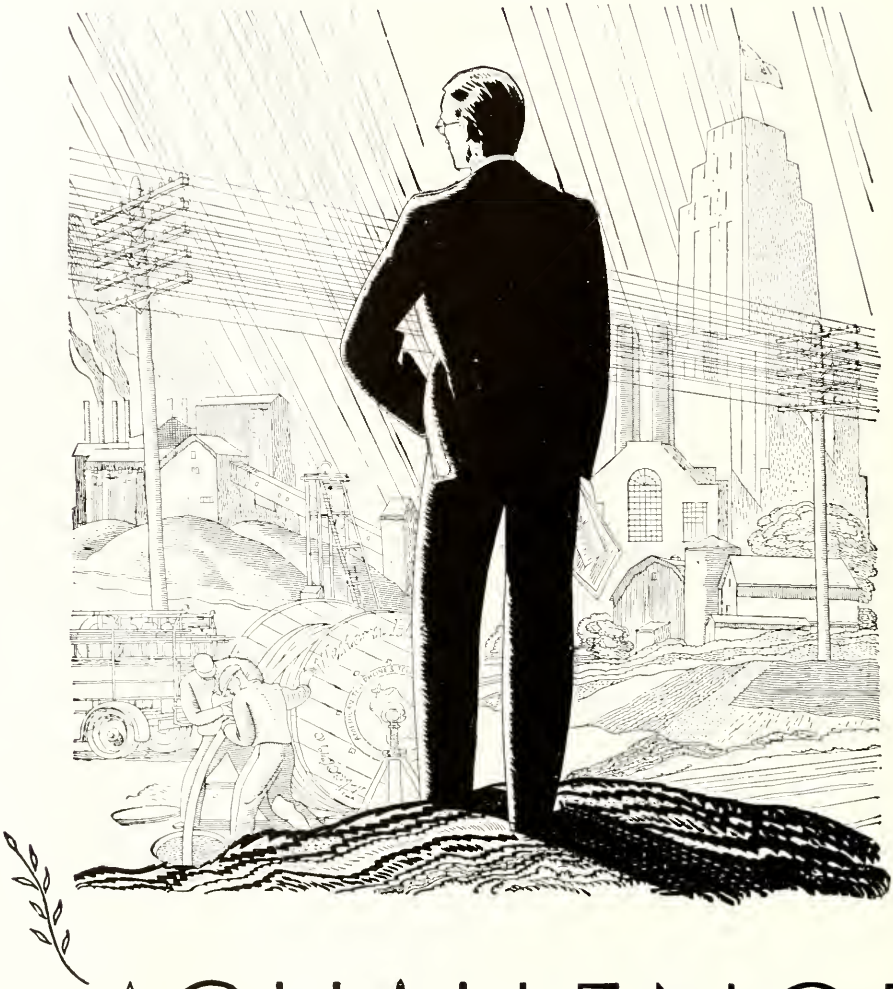
To obtain audibility of the human voice at a distance of 550 ft. in an open air amphitheatre was a problem that confronted California engineers and was successfully solved by constructing a steel superstructure of the form of half a truncated cone supported on a series of semi-circular steel arches. Ultimately the arches are covered with asbestos sheets. The skillfully designed orchestra shell, at the Hollywood Bowl, Los Angeles, California, has been tested for its sound reflecting qualities. In conducting the experiments, a No. 10 birdshot was dropped a distance of eight inches on a kettle drum and it was heard over the entire 25,000 capacity, bowl area.

The inner radius of the semi-circular arch in front of the shell is 42.5 feet while other arches range down to 15 feet at the small end, giving sufficient area for extravagant performances. The concentric reflecting surfaces overhead, with the exception of the extreme front and extreme rear incline 51 degrees to the horizontal. The reason for using several concentric circular bands was to complete the shell, which overcame the focusing effect of the sound. Sounds originating at any point on the orchestra platform are directed toward the listeners in the bowl, with a slight preference for those seated at the greatest distance from the stage. Those who are nearer receive an adequate amount of sound by direct waves and the compensation for the remote seats was made purposely.

Mobility of the shell was also desired, so it could be rolled out of the way in event of great pageants. This condition was met by equipping the superstructure with wheels and track to permit easy removal to a place 400 feet up a canyon where it would be out of sight of the audiences, leaving only the original stage with nature's glories as scenery.

Hydrogen Replaces Air

We have all known of hydrogen as a medium for leviating lighter than air craft, but the element is now being utilized as a cooling agent in an electrical synchronous condenser. By using hydrogen instead of ordinary air approximately 20 per cent greater efficiency is effected. The condenser which has been installed in a San Antonio substation is a 15,000 kva., three phase, machine operating at 11,500 volts, 50 cycles and 750 r. p. m.



A CHALLENGE
TO THE IMAGINATION

To provide telephone service of national scope, to manage and develop properties valued at more than three and three-quarter billion dollars, to maintain an organization of more than 400,000 people at highest efficiency—such work spurs the creative thought of men of the highest calibre.

Within the Bell System many have achieved outstanding success. Their work is not only in pure science and engineering, but in organization and management, in salesmanship, financial administration, economics and the many other fields vital to the growth of so great an enterprise.

Because of these men the Bell System is able to furnish the best all-around telephone service in the world. A progressive policy puts at their disposal every aid that a great organization can give.

Western Electric

MEETS THE CHALLENGE

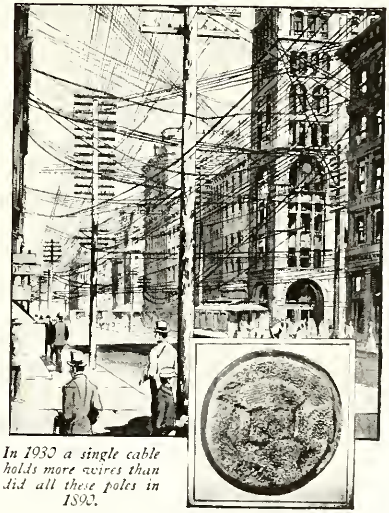
with manufacturing skill

As the science of telephony develops, the improvement of existing apparatus and the development of new types bring with them the need for constant change in manufacturing procedure.

A recent achievement in the manufacture of telephone cable illustrates the Western Electric Company's answer to this problem. The new cable carries 1818 pairs of insulated wires, 50% more than any previous one, yet it is no larger in diameter.

This cable makes feasible a 50% increase in the capacity of many existing underground telephone conduits. It will thus do away with the necessity of tearing up many streets to provide additional service and will prevent further overcrowding of pipes and wires under the street surface in congested districts.

Such a development saves time, money, and space. It benefits not only the Bell System but the public at large.



In 1930 a single cable holds more wires than did all these poles in 1890.

BELL SYSTEM

A nation-wide system of inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

UNBALANCED MOMENTS

BUSINESS BEFORE PLEASURE

Irate pater: "What do you mean by bringing my daughter home at this hour?"
Young Fellow: "Well, I have to be at work by seven."

We still maintain that a sorority is a broad activity.

She: I hear the professor has stopped necking and drinking on the campus."
Her: "Well, I should think he would. A man of his age."

There was an old sculptor named Phidias,
Who thought that all clothing was hideous.
He sculped Aph-ro-di-te
Without any nightie
Which startled the purely fastidious.

City Guy: "What happens to lawyers when they die?"
Wise Guy: "They lie still."

It seems to us that the talkies are getting voice and voice.

A woman is always perfectly willing to give you half the road. The trouble is she can't decide which half to give you.

The stranger laid down four aces and scooped in the pot. "This game ain't on the level," said Alkili Ike, "that ain't the hand I dealt you."

"With a job like that you ought to be fired with enthusiasm."
"That's just the trouble, I was."

While his mother was away on a visit, little Charley's nurse took him over to see his two old maid aunts.

"And how do you like living alone with your daddy?" asked one. "Do you hug him and kiss him?"

"Oh, yes," said the little fellow, "me hugged and kissed daddy last night."

"That's wrong," his nurse corrected, "You should say 'I hugged and kissed daddy last night.'"

"No, nurse," said Charley, "that was Friday night."

THE ONLY WAY

Then there was the Scotchman who was engaged to a girl who got so fat that he wanted to break off the engagement. But the girl couldn't get the ring off, so he had to marry her.

Here lies the body of Henry Fay,
Who died maintaining his right of way.
He was right, dead right as he sped along,
But he's just as dead as if he'd been dead wrong.

Asked to pray for warm weather so that her grandma's rheumatism might pass away, a five-year-old girl knelt and said, "Oh Lord, please make it hot for Grandma."

FROM THE GREEK

Place—Restaurant.
Cast—Waiter, Diver.
"You wan' zoup?"
"Do I gotta take zoup?"
"That's zoup to you."—Judge.

"How can I make Anti-freeze?"
"Hide her woolen pajamas."

JUST AN OLD SPANISH COSTUME

JUST A LITTLE MISUNDERSTANDING

He: "You look like Helen Brown."
She: "Thank you. I look even worse in white."

THE BRUTE

He: "Well, I was down to the city hall today and applied for the license so it won't be long now before—"
She: "Oh! This is so sudden!"
He: "Before I'll be able to take my dog out on the street without the dog catchers chasing us."

X: "How would you punctuate this sentence—'Mary went to the garden nude.'"
Y: "I'd make a (—) dash after Mary."

HOW IT ALL STARTED

A well dressed college man's shirts got too small for him, so he began to wear them unbuttoned at the neck and thousands of prep school boys thought it style.
—Calif. Pelican.

RAVINGS OF A FROSH

(With apologies to Mr. Holmes)

Ay, tear her tattered crank shaft down,
Long has it raced in "high,"
And many a heart has slipped a beat,
As it sounded passing by.
Beneath it hangs the old crank case,
Above, compressions roar;
The pest of all the boulevards
Shall rattle on no more.
As it sounded passing by.

With body all unused to care,
It shown in varied sheens;
Before garage men ever knew,
What high compression means.
No more she'll feel the throttle out,
Nor crimson stop lights see,
Nor instigate the paying of
The good laws speeding fee.

Oh! better that her ancient frame
Should go to Warshawsky,
Her exhaust in the junk yard echoed first,
And should at last there be!
Bolt to the frame her engine block,
We can't do any more,
And let her go out Gloriously
A' hitting on all four! —D. S. D

A hair on the head is worth two in the brush.

Home brew isn't always what it's corked up to be.

"Hey, Mike," said a workman to the other atop, "don't come down on that ladder on the north corner. I took it away."

An optimist is a fellow who takes the cold water thrown on his proposition, heats it with enthusiasm, makes steam and pushes ahead.

"Crank away, ole man," said the automobile, "that's how I got my start."

Collegiate: "How was that date you had last night?"
C. 2: "Not so good."
C. 1: "Gee, you get all the breaks."

BY GUM

Black: "I scuttled many a good ship in my day, but I had to quit the game."
Flag: "How come, matey?"
Black: "Pyorrhea, me friend. I couldn't hold a knife in my teeth any longer."

Boy: "Yeah, that's what I said! I'm a fraternity man and a gentleman."
Co-ed: "Listen, you don't look like twins to me."

HOW HERCULES EXPLOSIVES ADVANCE CIVILIZATION

EXPLOSIVES
MAKE NAVIGATION SAFER

WHEN ocean liners and tramps slip into friendly harbors, it is possible that explosives have cleared the way to a safe berth.

Explosives remove the hidden rocks which menace navigation; the same tool of civilization blasts the huge stones, which, as breakwaters, protect harbors from angry seas. Docks, piers, and countless construction jobs that are indispensable to marine safety and efficiency, can not be undertaken without explosives.

Guarding the world's shipping is just one of the many ways—on land and sea and underground—in which explosives are helping to advance our civilization.

In these achievements, Hercules explosives have played, and will continue to play, an important part.

As an engineer, you probably will want to know more about explosives. Write for a copy of *Dynamite—The New Aladdin's Lamp.*

HERCULES POWDER COMPANY
(INCORPORATED)
941 KING STREET, WILMINGTON, DELAWARE
B-6

PRECISION FREQUENCY DETERMINATION

(*Continued from page 87*)

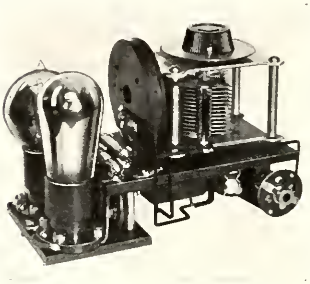
made to control directly the tenth harmonic of the 10 kilocycle multi-vibrator. In this case the harmonics of the 100 kilocycle crystal-controlled oscillator are used but they are weaker than the same harmonics obtainable from the 100 kilocycle multi-vibrator so that fewer of them are useful unless unusual care is exercised.

To determine the frequency of the working standard in terms of our primary standard time interval, an electrically driven synchronous clock is used. The clock is so constructed that when supplied with alternating current of exactly 1000 cycles per second it keeps exact time. If the supply frequency is greater than 1000 cycles per second the clock gains time, while if it is less than 1 kilocycle the clock loses time. The idea involved is exactly the same as that used in the operation of electric clocks operating from the 110 volt 60 cycle power line except that the supply frequency is 1000 cycles per second instead of 60 cycles per second.

The 1000 cycle current for operating the clock is obtained from a vacuum tube amplifier connected to the output circuit of the 1 kilocycle frequency divider. The difference between true time and time indicated by the clock operating from the working standard through the multi-vibrators is an indication of the amount by which the frequency of the crystal-controlled oscillator deviates from exactly 100 kilocycles.

The method of operating the complete frequency determining system is comparatively simple. It is only necessary to check the electrically operated clock, which operates at exactly a sub-multiple frequency of that of the crystal-controlled working standard, with astronomical observations. Then, knowing the ratio of the frequency of the clock to the frequency of the crystal-controlled working standard it is a simple matter to calculate the exact frequency of the working standard. Since all of the multi-vibrators are controlled by the working standard, all useful frequencies will have the same degree of accuracy as that of the working standard.

In calibrating frequency meters, vacuum tube oscillators, or quartz crystals from the frequency determining system, spot frequencies in decimal relation are available as useful output from the various frequency dividers. If the meter to be calibrated is variable over a certain frequency range it is a simple matter to calibrate the secondary meter in terms of the harmonics of the multi-vibrators. For obtaining intermediate points, auxiliary vacuum tube oscillators, which need not be calibrated in terms of frequency, are required for interpolating purposes. By combining harmonics of the multi-vibrator with various harmonics of the auxiliary oscillator, a very great many odd frequencies may be obtained for calibration purposes. The choice of the proper harmonics will give almost any desired frequency although if it is desired to do so the auxiliary oscillator may be calibrated from the working standard and used to determine frequencies not directly obtainable from the frequency determining system. The latter system is not so accurate as the former although it is more convenient in many cases.



Courtesy QST

The Oscillator and its Isolating Amplifier.

The electrically driven and controlled clock used in the frequency determining system is provided with a second hand and several other refinements permitting the time to be precisely determined to within 0.005 second. The time kept by this clock is checked against time signals sent from NAA, the government radio station at Arlington, Va. The time lag in sending these signals, due principally to the sluggishness of the electric relays at the U. S. Naval Observatory and at NAA is about 0.05 second, but the interval between two successive noon-to-noon transmissions is accurate to about 0.005 second. Therefore, the twenty-four hour time interval as defined by NAA time signals may be compared with the electrically operated clock on the frequency determining apparatus of one part in about 13,000,000 and the frequency of the working standard may be determined to a high degree of precision by this method. As a matter of fact, the precision with which the frequencies of the system may be determined is dependent upon the accuracy with which time is determined and defined by time signals, and until improvements are made in time determination methods there is little benefit to be derived from more accurate timing equipment on the frequency determining system It is ordinarily found that the frequency of the working standard is maintained over a period of twenty-four hours to within one or two parts in a million of the weekly or monthly mean frequency. When it is considered that this apparatus is manufactured in separate discrete units of such construction that the component parts may be installed in standard telephone repeater bays and made to function without tedious adjustments or without employing a highly skilled personnel, the value of such a standard is more readily appreciated.

It is possible, however, to keep the frequency of the crystal-controlled working standard to even closer limits than that obtained in the commercial standard described above, and it is expected that the new national frequency standard at the Bureau of Standards will ultimately maintain its frequency accurate to one part in several million.

The frequency standard used at the Bureau of Standards operates on exactly the same lines as have already been outlined but is naturally more highly refined and developed. Four temperature controlled boxes are used to house four separate crystal-controlled oscillators, all of which operate at 100 kilocycles. Any one of these crystal-controlled oscillators may be used to operate the multi-vibrators and the clock, the other three being used for comparison among themselves and for checking purposes. The sub-multiple generators in the new national standard are of different design than the resistance-capacitance multi-vibrators already described, but the principle of operation is much the same, and their function is exactly the same as that of the multi-vibrators.

Additional multi-vibrators giving frequencies as low as 1 cycle per second are used, the 1 cycle frequency divider being used to record on tape the time as defined by the frequency standard. Time as defined by NAA signal transmissions is simultane-

(*Continued on page* 114)

Holding Down Production Costs

Industry must be equipped to meet sterner competition. This means Industry must be *"Timken Bearing Equipped,"* and to you student engineers, future guardians of the nation's industrial prosperity, will come the opportunity to still further broaden Timken's scope for economical production.

For Timken can carry this responsibility as no other bearing because Timken carries all loads capably—radial or thrust, or both.

Lifting friction's load from power, production piles up into peaks. Maintenance cost swerves sharply into valleys. Lubricant expense clings closely to zero.

Exclusive with Timken are these distinct advantages—Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made steel.

It is through these advantages that Timken cuts production costs . . . through them *"Timken Bearing Equipped"* has become a universal guide for replacement of all types of industrial machinery *—wherever wheels and shafts turn.*

THE TIMKEN ROLLER BEARING COMPANY
CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

DEVELOPMENTS IN FIRE PROTECTION ENGINEERING

(Continued from page 94)

ated and motor-propelled pumper, carrying its own supply of hose and other equipment. Ladder trucks and other fire department apparatus are also self-propelled. The high speed with which a modern fire department is able to reach a fire adds to the effectiveness of operation. Conversely, it makes it permissible to provide for longer runs in planning the working schedule of the department. In a given city, the size and threading of hose couplings necessarily are those which are employed on the fire hydrants of the city. A difference in hose-thread size and pitch has sometimes made it impossible for a city department to assist a neighboring community to fight a fire which threatens to get beyond control. The use of the National Standard hose thread had been increasing, and now the fittings employed in most towns and cities are interchangeable.

In the field of so-called chemical extinguishers, the use of carbon dioxide is not new. For a long time it has been employed as the propelling agent in the common form of extinguisher which is charged with sulphuric acid and a sodium-bicarbonate solution, which react with each other when the apparatus is operated. Similarly, in the foam type of extinguisher, carbon dioxide may be the material which provides pressure; in addition it is the effective ingredient in the minute bubbles which constitute the foam discharge, and which by floating on the surface of a burning liquid tend to extinguish the fire by preventing access of atmospheric oxygen. In recent years the direct use of carbon dioxide in extinguishing fires has increased. Cylinders of the gas under pressure discharge through suitable pipe lines or hose. Apparatus employing this principle seems likely to have important application in fighting fires in enclosed electrical equipment, in the holds of vessels, in dip tanks and other tanks containing flammable liquids, and probably in other uses. The cleanliness of the method is especially attractive.

The modern high building, of the type called fireproof, usually contains a considerable quantity of combustible material in its wooden trim and wooden top-flooring. Moreover, its contents are combustible. Fire in the upper stories of such a building might easily be beyond control by the fire department equipment and methods of a few years ago. It is reported that a former chief of a great fire department, when asked what he would do in the event of fire in the upper stories of a 20-story building, then considered to be a "sky-scraper," said that he "would wait for it at the ninth floor." This is not the method of the modern fire-fighter. High buildings are provided with standpipe systems, comprising vertical pipes, with hose outlets at each floor, reliable sources of water supply, and provision for attachment of discharge lines from fire department pumpers. In a recent report upon conditions in New York City, the National Board of Fire Underwriters indicates that the protective equipment of high buildings, and the equipment and efficiency of the New York fire department give adequate security against the danger that a fire far above the street level may spread beyond control.

The royal feast was done; the King
Sought some new sport to banish care,
And to his jester cried, "Sir Fool,
Kneel now and make for us a prayer."

The jester doffed his cap and bells
And stood the mocking court before;
They could not see the bitter smile
Behind the painted grin he wore.

He bowed his head, and bent his knee
Upon the monarch's silken stool;
His pleading voice arose: "O Lord,
Be merciful to me, a fool!

"No pity, Lord, could change the heart
From red with wrong to white as wool;
The rod must heal the sin: but Lord,
Be merciful to me, a fool!

" 'Tis not by guilt the onward sweep
Of truth and right, O Lord, we stay;
'Tis by our follies that so long
We hold the earth from heaven away.

"Earth bears no balsam for mistakes;
Men crown the knave, and scourge the tool
That did his will; but Thou, O Lord,
Be merciful to me, a fool!"

The room was hushed; in silence rose
The King, and sought his gardens cool,
And walked apart, and murmured low,
"Be merciful to me, a fool!"

"The Fool's Prayer," by E. R. Sill

During the construction of many buildings, exceedingly large quantities of wood are used temporarily in the forms for concrete, the centering for tile floors, and in a forest of struts and scaffolding. Some spectacular fires in unfinished buildings in New York and Chicago indicate that this condition involves grave hazard. The remedies for the condition are two-fold; the use of incombustible material in forms and scaffolding, so far as this is practicable, and the installation and proper maintenance of standpipe systems during the construction period.

For many years, automatic sprinkler systems have had a notably good record in reducing fire loss. Recent developments in the design of accelerating devices attached to certain types of controlling valves, and the introduction of heat-actuated mechanisms of great sensitiveness, have enabled sprinkler systems to deal more effectively with quick fires in specially hazardous materials.

In the improvement in the science and the art of fire protection, Underwriters' Laboratories, the testing station of the National Board of Fire Underwriters, has had a great part. During the past ten years the reports of the Laboratories have covered investigations of fire hazards, fire extinguishing apparatus, building materials, and building equipment. The Laboratories' "label" is accepted as definite proof that a device or a material is constructed in accordance with the accepted standard for its class.

The national wealth of the United States is great; so also is the annual increase in that wealth. The values involved are largely in the form of property which is combustible or is otherwise subject to damage by fire, and the fire waste per year runs into hundreds of millions. The work of the fire protection engineer is to reduce the waste as much as possible. He must be well-informed regarding hazards. His suggestions regarding safeguards must be reasonable and practicable. He cannot prevent gasoline fires by eliminating gasoline. He cannot expect compliance with rules that interfere with normal industrial and social development. The importance of his work is recognized now to a far greater extent than was the case a few years ago. The history of recent years indicates that he is meeting his responsibilities with a high degree of success, and that even greater success is in prospect.

1/10th the Breadth of a Cat's Whisker

Between "Go" and "No Go"

THE painstaking spirit of the medieval monk has been handed down to the New Departure organization—and intensified in transmission.

Modern science has augmented the will to intensive effort with the ability to control the unseen and to detect the slightest deviation from exact physical truth.

Since much of the superiority of the New Departure Ball Bearings over other anti-friction devices is due to its precision of dimension, contour, and fit, a most elaborate and efficient inspection system has been developed.

Not only is every tenth man in the plant an inspector, but an average of 16,200,000 separate and distinct decisions are made each business day as to the acceptance or rejection of bearing parts. A single bearing, for instance, must be within proper limits on 90 separate counts to avoid rejection, with a tenth of a thousandth of an inch as a common unit of measurment.

In spite of these extraordinarily difficult standards set by New Departure engineers, New Departure special machinery—almost human in its operation; with *more* than human dependability . . . production proceeds with very little waste of time or material.

Is it any wonder therefore that New Departure Ball Bearings have the name of being the precision product of the world.

The New Departure Manufacturing Company, Bristol, Connecticut; Detroit, Chicago, San Francisco and London.

NEW DEPARTURE

BALL BEARINGS

THE CAR RETARDER

(*Continued from page* 91)

Before switching operations are commenced, the agent transmits his switching list, stating thereon the number and name on each car and classification track to which it should be switched. The list is usually transmitted for the entire train of cars which are to be isolated, before switching operations take place. In case the work must be expedited, switching operations can be carried on while the list is being transmitted. The operator would only require the list to be about five cars ahead of the actual movement of the cars.

The latest types of car retarders are all electrical units. The earlier types are of the electrical and air pressure combination style. The former units have proved to be more practical during the winter season. All of the piping and wiring leading to the retarders and towers is installed underground to provide protection against snow and rain.

Since the car retarder system is yet in its infancy, it will no doubt be improved. Both employee and employer will benefit from the results.

PRECISION FREQUENCY DETERMINATION

(*Continued from page* 110)

ously recorded on the same tape so that a permanent record of the two timing devices may be obtained. A comparison of the two time records may then be made to within 0.001 second. This high degree of accuracy cannot be fully utilized at the present time because time signals are not accurate to much better than 0.005 second. However, it is expected that improvements in time determination and signalling systems will be made at the Naval Observatory so that ultimately the new national standard of frequency will maintain its accuracy to approximately one part in 20 million.

DEVELOPMENTS IN CIVIL ENGINEERING

(*Continued from page* 96)

ties, high buildings must be designed to resist earthquake forces. Both wind and earthwork forces are still but imperfectly understood and much remains to be learned regarding the scientific design of buildings to resist them.

No absolute limit to building height seems to be in sight, so the future may bring out many interesting problems in design.

Roof structures over vast clear floor areas offer other problems of economical and ingenious design; the future will undoubtedly see startling developments in this direction.

The airplane, having passed the pioneer period, and the changes brought about by the war, is now in a period of development and refinement. There are some indications that we may soon have a degree of standardization of types of planes and motors.

Time, You Old Gipsy Man

Time, you old gipsy man,
Will you not stay,
Put up your caravan
Just for one day!

All things I'll give you
Will you be my guest,
Bells for your jennet
Of silver the best,
Goldsmiths shall beat you
A great golden ring,
Peacocks shall bow to you,
Little boys sing,
Oh, and sweet girls will
Festoon you with May.
Time, you old gipsy man,
Why hasten away?

Last week in Babylon,
Last night in Rome,
Morning, and in the crush
Under Paul's dome;
Under Paul's dial
You tighten you rein—
Only a moment,
And off once again;
Off to some city
Now blind in the womb,
Off to another
Ere that's in the tomb.

Time, you old gipsy man,
Will you not stay,
Put up your caravan
Just for one day?

—*Ralph Hodgson.*

The fundamentals of aerodynamics and airplane design are now pretty well understood due to the very great amount of research work that has been done. The designer is now able to foretell with fair accuracy the performance of his plane.

Research has extended to materials with the result that the engineer responsible for the structural design of an airplane now has available light alloy metals for different parts. A comparison of metal with wood construction is in many cases favorable to the former, and this is leading to the increasing use of metal structural parts.

The United States Department of Commerce has done, and is continuing to do, valuable work in requiring the building of airplanes that are structurally safe, and that have good flying characteristics. This includes the motors. All of the activities of the Department in regard to aeronautics tends toward the improvement and the stabilizing of the business of flying.

All of this aeronautical development and the Government requirement of high standards, is making work for the aeronautical engineer. There seems to be a demand for men who have the necessary technical training, and the probabilities are that this demand will increase.

In the Aeronautics Option of the Civil Engineering Department, with the subject of motors as given by Professor Roesch, the student is able to gain a knowledge of the fundamentals of the subject.

The Civil Engineer's connection with railroads deals with the construction and maintenance of the entire physical plant except rolling stock and signals.

The construction of new lines in this country has almost ceased, and will never again be an important part of railroad construction. Most of those now being built or proposed are relatively short but expensive links in existing systems, required to increase the efficient operation of the system as a whole rather than to open up new traffic territory.

Improvement of the railroad as a transportation machine is the main concern of managements at present. Great expenditures are being made to better operating conditions on main lines, and at important terminals. Many lines originally built in a cheap manner for light traffic are entirely rebuilt to reduce grades and curvature. Track structure is strengthened by laying heavier rail and deeper and better ballasting. Additional main tracks and passing tracks, widening of cuts and embankments, eliminating tunnels, strengthening bridges, reduction of short stretches of ruling grades all make possible the handling of more and heavier trains. Locomotives continue to become heavier and more powerful. To take advantage of these more economical units often requires heavy strengthening of track and structures on lines where they are to be used.

Terminals consist of classification yards, freight and passenger stations, and facilities for servicing of locomotives and cars. A great amount of reconstruction of old and inadequate terminals has been carried out in recent years and much more remains to be done. Improvements include more and longer yard tracks, new stations, engine houses and shops, water, coal and cinder handling facilities.

TIME—THAT TOUGH OLD TESTER....

Meet Time, that tough old tester of everything in this world. To his aid, Time calls all the destructive forces of the universe. Years come and go, storms and sunshine, heat and cold make their accustomed rounds, while Time, the tough old tester, broods over the world, trying, testing, destroying.

Yet Time, the tough old tester, does have his troubles. Against one material devised by man, Time and his serving-men falter. That material is genuine Puddled Wrought Iron—the metal of which Reading 5-Point Pipe is made. Watch for the next coming of Time, the tough old tester—you can learn about pipe from him.

READING IRON COMPANY, Reading, Pennsylvania

For Your Protection, This Indented Spiral Forever Marks *All*

5 POINT PIPE
READING
GENUINE PUDDLED WROUGHT IRON
DEFIES VIBRATION
RESISTS CORROSION
HOLDS COATINGS
THREADS EASILY
WELDS BETTER

GENUINE PUDDLED WROUGHT IRON
READING PIPE
DIAMETERS RANGING FROM 1/8 TO 20 INCHES

Science and Invention Have Never Found a Satisfactory Substitute for Genuine Puddled Wrought Iron

ELECTROLYTIC WHITE LEAD

(*Continued from page 89*)

the catholyte is from 3 to 4 gal. per minute.

The catholyte is carbonated by passing it down through towers in the form of a shower against a rising stream of CO_2. Three towers are used, each 7x7x25 ft. high, lined with steel, and packed with porcelain tower filling. Solution to the depth of 24 in. is kept at the bottom of each tower at all times. The CO_2 is produced by burning coke in a locomotive boiler. The gas is first passed through a wet cyclone collector which removes dust, and traces of SO_2. It is then passed through a series of towers, similar to the carbonating towers, which are filled with tile and which remove any remaining dust or moisture. The purified CO_2 is pumped, at a pressure of 2 lb., to the carbonating towers; it enters through the bottom through perforated steel plate, passes up through the head of catholyte, up against the falling shower, and is then discharged to the atmosphere. A CO_2 recorder is used for control.

The anolyte as it leaves the cell must, however, undergo an entirely different treatment since it contains the precipitated white lead. It first flows to a sump where it is passed through a 100-mesh screen to remove any foreign matter which might later cause trouble. From the sump the anolyte is pumped to a standard Dorr thickener, 25 ft. in diameter and 10 ft. high. The solution enters the thickener carrying about 0.5 per cent solids, and leaves the thickener at about 20 per cent solids. The overflow from the thickener is a clear solution and it is returned to the cell. The only losses in the anolyte are mechanical ones which are at intervals replenished. The thickened pulp is pumped to a 7500-gal. storage tank prior to filtration. Here an additional small amount of concentration takes place; when the pulp is ready for the filters, it contains about 30 per cent solids.

The primary requirements of the filters are that they wash the white lead free from all soluble salts, and that the filter cake contain as little moisture as possible, to lower the cost of drying. The present installation of filters consists of seven rectangular, concrete tanks 7x7x7½ ft. deep, over which filter frames are placed. These filters are of the Moore type and are vacuum operated (a vacuum of 20 to 26 in. is carried). Perforated pipes are placed in the bottom of each tank to supply air (at about 5 lb.). This air is used for agitation. The pulp is washed by four counter-current washes of 600 gal. and for about 40 min. each, and a final wash of 5000 gal. of pure water at 125 F. for about an hour. A great deal of care is taken with this final wash—the length of the wash depending upon samples which are taken at regular intervals. A cake 2 in. thick and weighing approximately 4000 lb. net is built up on the filter frame in about 20 min. This cake contains approximately 50 per cent moisture. It is then pumped, by a gear pump, to an Oliver filter which reduces the moisture to 35 per cent.

The drying system which is in operation today has been changed from that which is shown in Fig. 2. A Lowden dryer, having a steam-jacketed hearth of cast aluminum 12x60 ft., is in use with decided success. Although such a unit represents a considerable expenditure, nevertheless the freedom from contamination was considered sufficient to compensate for its cost. The pulp from the Oliver filter is fed to the dryer and it is moved the length of the dryer by rakes which move eccentrically. The time required for the pulp to move the length of the dryer is about 2½ hr. The dryer yields a product containing 0.8 per cent moisture.

Although the material is dry as it leaves the dryer, it is in a form similar to lump starch which disintegrates into a fine powder under slight pressure. In order that the white lead may be delivered in a uniform size, the feed from the dryer is sent to a three roller Raymond mill. This operation is not a crushing operation since the particle size was determined by the size of the precipitate in the cell; it is essentially a pulverizing operation. This mill is equipped with a heated air supply which is used to float the product of the mill and to insure a complete removal of moisture. The air-floated product is sent to the packing room where it is packed into barrels and stored for delivery.

In addition to the data already given in this article, the following operating data are tabulated:

New anode weight, pounds	250.0
Scrap anode weight, pounds	75.0
Time of corrosion, hours	85.0
Current efficiency, per cent	97.0
Dried product, per ct. moisture	0.20
Dryer temp., max. degrees C.	120.0

The product obtainable from this process is said to be superior to that of other white lead processes. Its merits are uniform composition, exceptional purity, and remarkable hiding power. It is a true basic carbonate. The product of this process is a brilliant white due to its purity and fineness, and has found considerable use where a pigment having these qualities is demanded. With the combined efforts of the experimental and research men, and with increased demand for this product, the expansion is due to be unlimited in the production of the ancient and modern article of commerce.

DEVELOPMENTS IN MECHANICAL ENGINEERING

(*Continued from page 95*)

creased until the actual boiler heating surface is only about 12 per cent of the steam-generating-unit heating surface.

Some idea of the economy effected in central stations may be gained from the following; in 1929, the average coal consumption per kw.-hr. was 3.2 lb.; in 1928, 1.8 lb.; in 1929 twenty stations averaged 1.5 lb. and seven stations in the neighborhood of 1.0 lb.

In the industrial plant, correlation of steam and power loads have made economies exceeding those obtainable from the highest type of condensing plants. The present practice is to start with the process load and then raise the steam pressure to the point where all the power needed is generated as a by-product. Under these conditions, when utilizing the entire exhaust in process work or for heating purposes, power is produced on a basis of approximately 4000 B. t. u. per kw.-hr. as against 12,000 B. t. u. for the most efficient type of central condensing station.

The mercury vapor units in the Dutch Point Station and the South Meadow Station of the Hartford Electric Light Company are in regular commercial operation and it is purported that the combination steam and mercury process at these plants is producing a kilowatt hour on a heat consumption of 10,500 B. t. u. and at a cost comparable with that of the best straight steam stations. No other commercial installations of mercury-vapor units, however, have been reported.

Combination coal-processing and steam-power plants for the purpose of generating electricity through a decrease in cost of boiler fuel by

IN THE STEEL FOUNDRY

THE oxy-acetylene process is of particular importance to the foundry industry. Its use has enabled designers and makers of castings to accomplish results otherwise impossible.

Oxy-acetylene cutting is recognized by steel foundrymen as superior to all other methods of riser removal. It is fast and economical. In addition it reduces to a marked degree the amount of machining necessary to the casting after the risers are cut off.

Reclamation of castings by oxwelding is a natural adjunct to riser cutting. It has enabled foundry operators to reduce rejects to a minimum. Castings so reclaimed are in all respects equal to those accepted upon first inspection.

Oxy-acetylene cutting and welding are routine production steps in the modern foundry.

JOHN F. WILCOX
Leland Stanford University 1921
Crew Soccer

VINCENT DRADDY
Manhattan College 1929
Football 3 years
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From time to time the oxy-acetylene industry is in the market for technically trained men. It offers splendid opportunities for advancement.

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The Linde Air Products Company—The Prest-O-Lite Company, Inc.,—Oxweld Acetylene Company—Union Carbide Sales Company—Manufacturers of supplies and equipment for oxy-acetylene welding and cutting.

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30 East 42nd Street New York, N. Y.

processing the coal with a recovery of byproducts have reached the commercial stage in development and a number of small plants have been in operation for some time but no data are available as to their commercial economy. The largest project of this kind is the low-temperature carbonization and power plant of the Industrial Power Corporation which is to supply electrical power, gas and process steam to the manufacturing and stock yard district of Chicago.

Progress in aeronautics, machine shop practice, railroad engineering, refrigeration, heating and ventilating, hydraulics, materials handling, textile manufacturing, iron and steel industry and in the other numerous branches of mechanical engineering has been fully as impressive as in the power generating field but lack of space prevents even a "high spotting" of the more important improvements.

DEVELOPMENTS IN CHEMICAL ENGINEERING

(Continued from page 93)

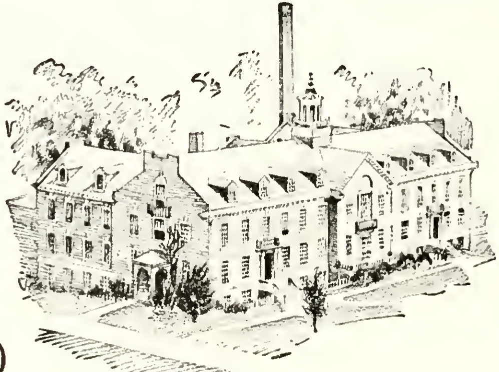
Ten years ago there were only a few small plants operating in this country. Today, there are a dozen very large ones and the production of rayon is increasing by millions of pounds each year.

The increase in the production of rayon has, of course, been in response to the additional demand for the product. But without the developments brought about in the industry by chemists and chemical engineers, the demand for the product would not have increased so markedly. Changes in process have produced a product much superior to that produced a few years ago and these changes in process have also lead to marked reductions in cost of production. We, therefore, have a better product which can be sold at a lower price and these two considerations have assisted very materially in expanding the demand for the product.

The continued expansion of the cracking of paraffin hydrocarbons to produce marketable gasoline has been due to the improvements brought about by the chemical engineers as much as has the increased demand for the product. The chemical engineer has been concerned in devising more economical furnaces for heating the oil to be cracked, in designing better heat exchangers to conserve the heat in the hot vapors, and in designing more efficient fractionating columns to be used in the preparation of the final marketable product. He is also interested in developing new processes. It is my opinion, however, that in recent years his work in the development of new processes has amounted to little as compared with the improvements he has been able to make in processes already developed and installed.

It has been impossible to comment, even briefly, on all of the most important, recent developments in chemical engineering in this article. I have attempted to select only the most outstanding ones.

The chemical engineer in recent years, like other engineers, has availed himself insofar as has been practicable of automatic methods of control, such as: devices for controlling temperatures, pressures, flow of liquids, flow of gases, control of moisture content, control of thickness and weight of sheet material being fabricated, etc. These automatic methods of control have aided materially in bringing about cost reduction in many industries, and it is along such lines that we may expect continued development in the years to come.



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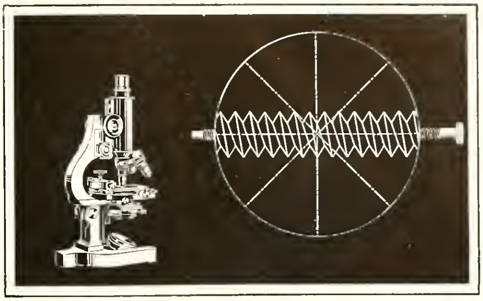

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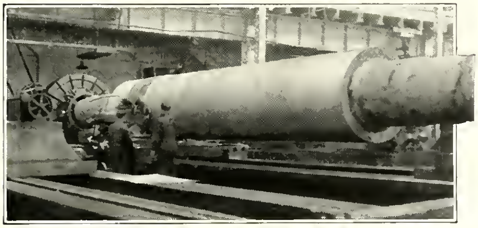

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Will be Sent on Application

DEVELOPMENTS IN ELECTRICAL ENGINEERING

(Continued from page 92)

These higher voltages have helped to promote consolidations of generating systems through interconnection so that greater economy in operation and improved reliability are both possible. As a result, we have less than half as many electric power and light companies as we had ten years ago.

In the field of transporatation, the developments have not been as rapid as in some other lines. The electrification of railroads has not progressed as rapidly as many electrical engineers have desired, but there has been some development, particularly in the use of high-voltage direct-current. We have now reached a value of 3,000 volts between the trolley and rail. A contribution to that development has been improvements in the design and size of mercury arc rectifier which makes these high voltages attainable easily and economically.

As a partial substitute for electrification of steam railroads, we have developed gas, electric and Diesel-electric locomotives. These locomotives have shown improved economy over the steam locomotives and the same idea has been applied in buses for public transportation. In street railroad practice the recent tendency has been toward lighter weights, greater speeds and more comfortable seating in cars for surface transportation. A further development where traffic is light is the use of the one man type of car. Most of these changes have been stimulated by bus competition. In vertical transportation by elevators and hoists the quality of the service has been greatly

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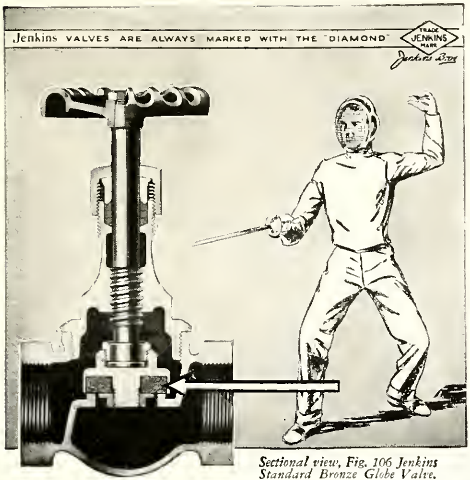
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Sectional view, Fig. 106 Jenkins Standard Bronze Globe Valve. Arrow indicates renewable, resilient disc.

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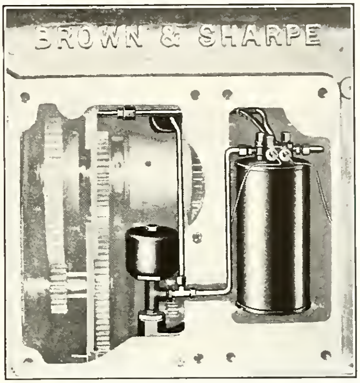
AUTOMATIC LUBRICATION
—for all units in the column, the driving clutch, and the knee mechanisms of the BROWN & SHARPE STANDARD MILLING MACHINES



THE lubrication system of the Standard Milling Machines is an important assurance of a long lifetime of efficient performance.

Filtered oil is automatically supplied to all bearings within the column and in the driving clutch by a plunger pump, assuring ample lubrication. A gauge on the side of the column indicates the pressure. A separate pump—cam driven—supplies oil to the knee mechanisms.

This assurance of plenty of oil to all moving parts increases the life of the machine and eliminates the uncertainties of hand oiling.

BROWN & SHARPE
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improved with an increasing tendency to automatic features such as completely automatic elevators or automatic levelling at floors when there are operators and, in case of hoists, of automatic unloading

In aviation, electric energy has found a field of many applications. One of the first was the lighting of landing fields and of lanes so that night flying became practical. In addition, a number of instruments have been developed so that in connection with radio it becomes possible to leave a flying field and land in a fog. Since the fog has been recognized as aviation's worst enemy, the electrical developments which have found the dangers of flying in fog are of great importance.

There have been many improvements and developments of a minor nature during the past decade, some of which have reached considerable commercial value. Among these may be mentioned the electrical method of making original phonograph records. The tube amplifiers, originally developed for radio, were here put to another use so that a better mechanical record was obtained. Another development consisted in making the record photographically on a continuously moving film.

In the case of the mechanical record, reproduction could be obtained in the usual mechanical way or an electrical "pick-up" could be used feeding into tube amplifiers with the output going to a loud-speaker. In the case of the photographic record, the services of the photo-electric cell were called for. This light-sensitive device, known for many years, became practical when it could work in conjunction with sensitive amplifiers. The combination thus made possible sound reproduction from photographic records. Both of these methods of sound reproduction have helped to make possible the "talking movies" and thereby start a rapidly growing industry.

It may be added that the photo-electric cell with associated amplifiers has found many useful applications such as measuring the candle-power of lamps, counting objects, sorting things according to shade, turning on and off lights, etc. Perhaps its most striking application has been in connection with television and in the transmission of pictures and other facsimile copies either by wire or by radio. The idea of transmitting pictures by wire is old but it became practical only recently.

Another line of development has been in the use of high-frequency currents to act as carriers in communication over wires. Their use has made it possible to have a large number of "channels" for telephone and telegraph mesages over one pair of wires. The scheme has also been adapted to inter-communication by power lines and has been tried experimentally for broadcasting over wires.

It is not possible in the brief space allotted to this article to discuss all phases of recent electrical progress. The growth of electric welding, the improvements in switches and lightning arresters, the effect of studies with oscillographs, the continuous loading of submarine cables, and many other things not mentioned have contributed to a decade of electrical development at a rate never before experienced. Thus, as we pause to look backward, we observe that we are progressing with increasing swiftness; and as we glance ahead, we see no tendency to slow down.

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Harnessing Niagara Falls to the washing machine

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While, step by step, this progress has taken place, the many men who have contributed to it could not know what far-reaching results it would have. Now the ultimate boons grow clear. Water power development becomes a national policy, steam bids fair to rival water power for cheapness, economically produced power brings more plentiful goods, lights houses and hauls crowds in cities, is carried to rural sections to lift washday drudgery from farm women's shoulders.

Among the many industrial victories that are behind this revolution, none is more important than wider knowledge of piping materials and better materials. One of the highly prized chapters of our history is the contribution that Crane research and valve engineering has made to the general advance. The results of this research are embodied in a Crane book, *Pioneering in Science*. It is a fascinating story of engineering development and a valuable reference work for engineering students. A request will bring you a copy.

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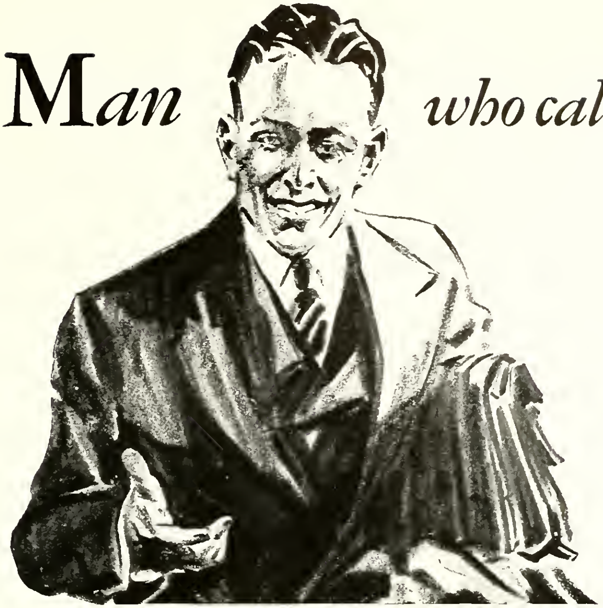

YOU like his quiet enthusiasm, but you like even more his complete and competent answers to your questions. And you admire his assurance in making equipment recommendations, in detailing performance characteristics, in quoting prices and deliveries, because he quite evidently *knows* his subject.

What is his authority so thoroughly to commit his house? What is the basis of his positive knowledge? Just this . . . he is a Worthington post-graduate.

He and his colleagues, in Worthington engineering, production and sales, were recruited from the graduates of representative technical schools. They doffed their caps and gowns for overalls, laid down their sheepskins for machinists' tools, and gladly spent many months in the Worthington plants at Harrison, Holyoke, Buffalo and Cincinnati. They took a thorough post-graduate course in Worthington Engineering. When they finished, they were Worthington men in fact as well as in name. It is significant that 76 out of every hundred of these candidates become permanent Worthington representatives.

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achieved by the revolutionary
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You probably thought it simply impossible to improve the flavor of Star Ham. It was tender, tasty, and tempting—all a ham could be. But Armour and Company, with the responsibility of leadership, wasn't satisfied to stop.

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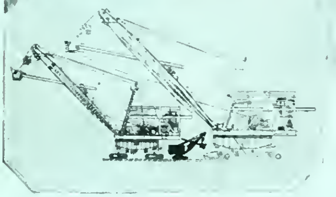
Try a Star Ham for dinner tomorrow. Notice how pink and plump it is. Notice the nice proportion of lean to fat. Cook it in the regular way. We can predict your verdict. You will say "Star" to your dealer from now on. Armour and Company, Chicago.

Armour's Star Ham

with the Fixed★Flavor



A comparison: the big shovel; the previous record size; and, in solid black, the standard-size excavating shovel

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9 Stories High

ONE man easily controls the excavating operations of the world's largest shovel, now stripping coal at Duquoin, Illinois. Yet this shovel weighs as much as 20,000 men.

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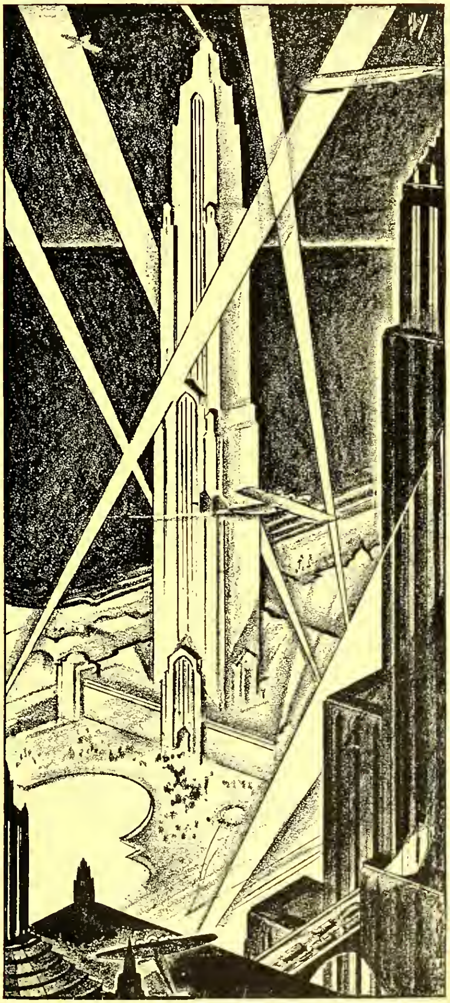
VOL. XXI.
No. 4

MAY
1930



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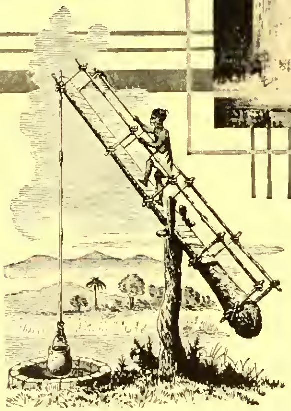

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RESISTS CORROSION
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Nine years ago the University of Pittsburgh, then a hundred and thirty-six years old, faced an urgent need for larger quarters. To extend its restricted campus was almost out of the question, for a city had built up around it. The logical direction for expansion was into the air.

American business had long before faced the same situation, and met it with the skyscraper. But no conventional business building would satisfy here. Chancellor John Gabbert Bowman envisioned a Cathedral of Learning, an edifice that would express the essential self of the steel center of the world, a structure with more power, more spirit of achievement and reverence in it than had ever before been attempted. A great architect put his soul into the making of the plans. Leading suppliers were called on for the materials for the realization of Chancellor Bowman's dream.

To Westinghouse engineers came the assignment of providing the electrical and elevator equipment for this great structure. Recognized as a great clearing house for electrical development, the Westinghouse organization draws interesting assignments in every field of human activity.

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THE ARMOUR ENGINEER

Published Quarterly by the College of Engineering

ARMOUR INSTITUTE OF TECHNOLOGY

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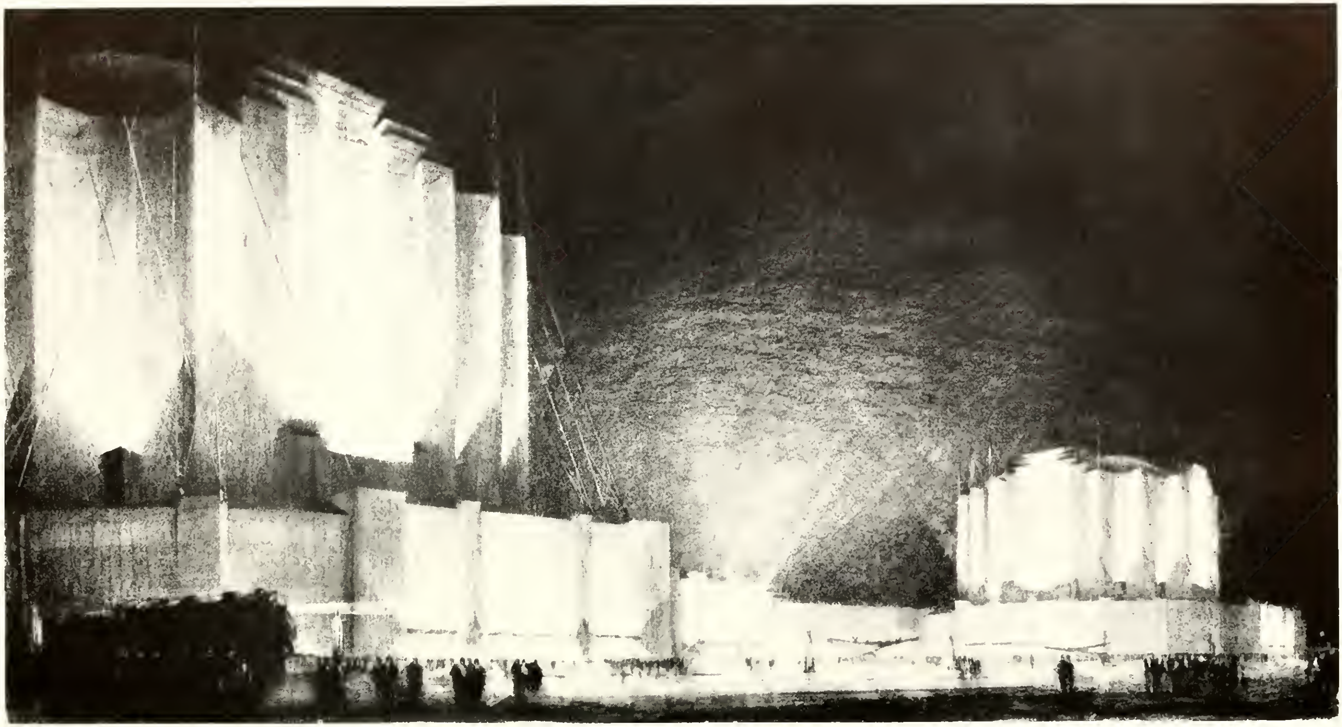

The Proposed Transportation Building — Chicago World's Fair of 1933

The
ARMOUR ENGINEER

VOLUME XXI MAY, 1930 NUMBER 4

A Century of Progress

By A. J. Lenke, '31

Student in the Department of Fire Protection Engineering

DURING the middle months of the year 1933, leaders in the world of thought and industry will display a structure which will express, in exceedingly clear terms and form, the achievements of science that have been responsible so largely for the benefits which the human race now enjoys. This event, —The Chicago World's Fair Centennial Celebration,—has been in the process of development for nearly two years. For the birth of the idea, the sponsors of the Exposition are indebted to a few far-sighted men and women who realize that the world has progressed so rapidly and so far in the past one hundred years that noteworthy recognition should be made of the fact.

Because the United States has risen from a minor place among the powers of the world to one of greatness in science, finance, commerce, education, sports, and the arts, it behooves the entire world to take cognizance of the serious purpose which underlies the Fair to be held in 1933. Originally conceived as a celebration of the one hundredth anniversary of the birth of Chicago as a municipality, the idea has grown to be one of international importance. It was one thing to celebrate the birthday of a city, which now ranks as the third largest in the world, but quite another to commemorate one hundred years of scientific accomplishment. Therefore the original name of the proposed Exposition,—Chicago World's Fair Centennial Celebration of 1933,—was changed to "A Century of Progress", the more nearly to define the outgrowth of the original idea.

In the record of world events, the fact that the City of Chicago has become a giant among the cities of the earth in the short span of a century, sinks into insignificance when compared with the fact that the city is now recognized as the heart of the nation. One hundred years ago Chicago was a frontier settlement; today it has a population of over three million persons. In the districts immediately surrounding the city limits there is a population which brings the total of human inhabitants to nearly five million.

> *A Century of Progress! Surely never before has there been a like period, during which such radical changes have taken place. Progress has been made in many fields; in Education, in Philosophy, in Art, in Law, and in others, but among all these, progress in Science has been by far the most remarkable. Revolutionary discoveries in Science and their common application have affected life today more than all of the others together. What is the Fair then, but a tribute to the scientist and the engineer; men who have done so much for modern civilization.*

By virtue of the importance of its geographical location, of its being the focal point of habitation, of its triumph over adversities of major importance, and of its struggles to assume a place among the leaders in industrial achievements, as well as among those communities which have acquired a reputation for culture, Chicago becomes the logical place in which the progress of the world during the past century can best be shown. In a large measure, the growth of its second city has been a product of the growth of the United States and the national development to the westward. The present center of population of the United States is about one hundred and fifty miles south of Chicago; the center of agriculture is about two hundred miles southwest of the city; and the center of industrial production is only twenty-five miles southeast. Can there be any doubt, therefore, as to the selection of Chicago as the strategic location for a great world event?

For the main theme of the Exposition, science—both pure science and science as applied to industry—was chosen. The aid of the National Research Council was solicited and that body in turn appointed a committee of about forty outstanding scientists to act as heads of subcommittees. They as chairmen appointed other noted scientists in the varied fields of research, and consequently there are now over four hundred of these men devoting a large proportion of their time and thought to means whereby the theme or philosophy of the Exposition may be best interpreted for "show purposes."

The actual exhibits of "A Century of Progress" will be the product of scientific, industrial, and social agency, organized in functioning for the promotion of industry and the betterment of human beings, rather than for the advancement of competitive individual interests. In other

words, the World's Fair of 1933 will not be of the pattern of former fairs, in that it will not be of competitive trade exhibits. Of necessity, the Exposition must retain many of the features of the past, although brought up to date and modernized. These will have to do with the landscaping and lighting effects, with the amusement features, and with the presentation of the products and industries of various nations. However, the exhibits themselves of the "Century of Progress" of 1933, portraying the relation of science to advancement, will be totally unlike any international exhibition ever beheld by man.

The relation of foreign governments to "A Century of Progress" remains to be determined by those governments and the peoples whom they serve. No other object appears more important than the use of the Centennial Celebration to advance the cause of international peace and to foster more intimate knowledge of other lands among the people of the United States.

In the science displays there will be no consideration of national or territorial boundaries. The story of each branch of science will be told as a story of a debt of humanity to pioneers and developers without regard to nationality. It is desirable, however, that the exhibits of foreign nations shall follow the general pattern of exhibits from the United States, in so far as this shall be found applicable, appropriate, and practical.

The general plan for "A Century of Progress" has been developed with the possibility in mind that the Fair may extend along the lake front opposite Chicago, from Monroe Street on the north to Forty-seventh Street on the south. The plan as developed, concentrates the main features of the Exposition within the area between Roosevelt Road and Thirty-ninth Street. The existing island which has been created east of the Field Museum and Soldier's Field, will be utilized for the World's Fair buildings, while to the south of this island a small extension will be made for the purposes of the Fair. According to the present plans, no further filling in of the lake for the creation of new islands will be necessary.

The location of the Fair on the lake front starts the Exposition with a greater nucleus of existing buildings than any past event of its kind. In the Field Museum, the Stadium, the Shedd Aquarium, the Planetarium, and the Art Institute, the Fair starts with a collection of buildings which could not be reproduced for many millions of dollars elsewhere.

The plan of the Exposition, as developed by the Architectural Commission, is a departure from past practices in the planning of such events. In most of the former expositions, held in this country and abroad, maximum use has been made of symmetry in design. In other words, there has been perfect symmetry about the main axis of the Exposition. A building on the right of this axis has in its main form, mass, and detail been very similar to the balancing building on the left. A tower on the right called for a similar tower on the left. The plan, as developed by the Architectural Commission, utilizes balance in composition, but not symmetry. It is dissymmetric in principle. The adoption of this scheme was necessary partially because of the shape of the site and partially from a desire for innovation in design.

As the details of the plan now appear, the main group of exhibit buildings is to be between Sixteenth Street and Twenty-fifth Street. These buildings are to be built about the lagoon, and their walls are to be stepped back as they rise, in the form of terraces. This terracing will form an amphitheater for the Exposition crowd, from which they will be able to view the water pageants which will take place in the lagoon.

No attempt will be made in the construction of the Fair buildings to compete in height with the skyscrapers of Chicago. They will be comparatively low buildings, the highest being a tower which will be erected on the island opposite Twenty-second Street. This feature as developed by the Architectural Commission will use for its decorative elements the beauties of falling water which will be pumped to the top of the tower and allowed to cascade down its sides.

The Administration Building of the Fair will occupy space on the shore of the lagoon near the Field Museum. It will be located on the east side of the outer drive, with its great central hall lying at the head of the road between the Field Museum and the Stadium. Work is to be started on this structure this spring.

The spring of this year will also see the breaking of ground for the Transportation Building, which will extend from Thirty-first to Thirty-fourth Streets. It is to be made up of two great domes connected by a low building 1,070 feet long. The two domes are about 206 feet in diameter, each set on a base which is 300 feet in diameter. The dome structures are 125 feet in height. These dome towers will be absolutely unique in construction, the domes being suspended by steel cables from the exterior. The prin-

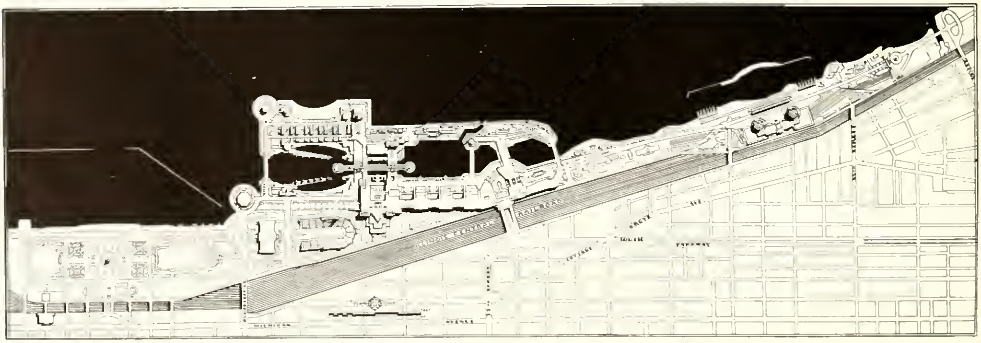

Diagram of the general plan for Chicago's Century of Progress Exposition, showing the intended development along the lake front.

ciple of this design is similar to that of a suspension bridge.

The Travel and Transport Show, which will take place in and about the Transportation Building, is divided for organization, primarily, into four major divisions: railway, highway, waterway, and airway. For exposition purposes, it divides itself into two parts, namely: still exhibits, and pageantry which will dramatize transportation. In the exhibit division there will be ships, locomotives, airplanes, motor vehicles, etc., all standing in fixed position, but dramatized to a considerable extent to show their development and history. In the pageant there will be a parade, passing a grandstand facing Lake Michigan. This will depict in a most colorful way one hundred years of transport—all the way from the stage coach, the freighting wagon, and the early locomotives of 1833 to the highly modernized trains and the powerful trucks of today. In the waters of the lake there will be a similar picture of the growth of waterway transport from the first river boats and lake steamers to the most modern water craft we now have. Overhead will pass the many varieties of airplanes and airships. No phase of modern transportation is to be ignored in this exhibit, which will be one of the chief features of the Fair.

Of the artistic features of the Exposition—its outside and inside embellishments—little need be said, except that the talent of the world will be drawn upon to make "A Century of Progress" the most beautiful world's fair of history. Just as painting, sculpture, music, and pageantry have played a big part in past expositions, so too, will they have their due measure of importance in 1933. The dance previously has received scant attention. Now, because there is a renaissance of this art, and a great new development of its various forms in all countries, the dance will undoubtedly be an important feature among the great stage and outdoor spectacles that are scheduled for the entertainment of visitors to the Centennial Celebration.

Plans are being formulated for the most important carnival of sports in the history of sporting events. Leaders in every branch of sport are lending their aid toward making that object an actuality. It is hoped that arrangements can be made for exhibitions and programs of such sports as archery, baseball, football, soccer, lacrosse, boating, yachting, swimming, golf, tennis, trap shooting, horse racing, polo, cricket, wrestling, boxing, dog racing, auto racing, equestrian sports, marathon racing, and many others.

One of the big problems in connection with the Fair is the transportation of the people while in attendance at the Exposition. It is necessary that there shall be no inconvenience in the handling of this matter for upon it rests the welfare and comfort of the hundreds of thousands that will attend the celebration. If present plans are carried out, visitors will be conveyed to roof levels. From there they can descend to ground level in easy stages by means of ramps. Water taxis and other appropriate transport will convey them around the grounds. Every means will be provided to obviate fatigue. In walking or riding about the Exposition grounds the visitor will pass over upper level trestles or foot bridges connecting one building with another. No detail is being overlooked to make the Exposition visitor constantly comfortable. Walking will be reduced to a minimum, all walks and floors will be made as resilient as possible, and every effort will be made to keep the buildings cool and well ventilated. Also, they will be made as fireproof as it is practical to construct them, and ample fire protection will be provided.

All funds for the general purposes of the Exposition have been contributed by public-spirited citizens of Chicago, either outright with no thought of return, or through the purchase of securities. The Founder Members of the corporation contributed the sum of one thousand dollars each. This group has been considerably augmented since the inception of the organization, and their contributions have helped materially in defraying operating expenses.

In 1929 an intensive drive was conducted to find out if Chicago really wanted a world's fair. Nearly 125,000 people in metropolitan Chicago answered in the affirmative by becoming members of the Chicago World's Fair Legion and, in attestation of their good faith, subscribed five dollars each to the cause. The funds thus obtained will not be used for operating purposes until the opening of the Exposition, when they will be considered as gate receipts, because every Legion member is entitled to ten tickets of admission.

The first step in the major financing of the Exposition was the authorization of an issue of six per cent guaranteed gold notes maturing October 15, 1935, in denominations

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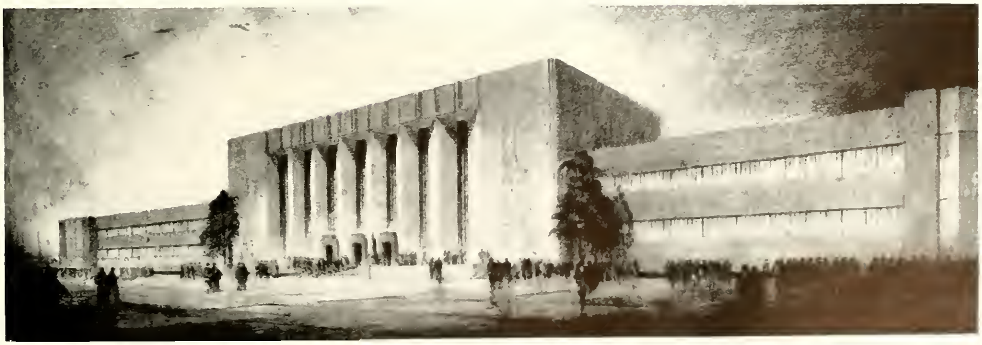

Drawing giving a general view of the main facade of the Administration Building, work upon which is to be started this spring.

Anemometer Measurements at Grilles and Registers

By Lynn E. Davies, '19

Assistant Professor of Experimental Engineering

WITHIN recent years there has been a rapid increase in the use of mechanical ventilation in public buildings and even to some extent, in private residences. This growth of the industry has been accompanied by an increasing demand for simple yet accurate means of testing these systems after they have been installed, in order that the various interested parties, owners, architects, contractors and city officials, may all be assured that the apparatus is performing properly.

The complete test of a ventilating system involves many factors, such as temperatures, humidity, power consumption, CO_2 content, odors, drafts, and volume of air. Of these various items, one of the most important is the volume of air entering a room or drawn from the room by the ventilating fan. This air in most cases enters or leaves the room, through grilles or registers, at rather low velocities and the testing engineer is faced with the problem of measuring the volume in some way at or near the register face. At the present time only one type of instrument is available which is suitable for this purpose, namely, the anemometer.

The anemometer, shown in Fig. 1, consists of a set of flat inclined vanes, resembling a small windmill, which rotate as the air passes through them. These vanes are connected through a train of gears to a center dial on which may be read the linear feet of air which have passed the instrument during any given period of time. From this, of course, the velocity may be calculated. In using the instrument the entire air stream is divided up into a number of small equal areas. A reading is then taken with the anemometer at the center of each area. The velocities obtained are averaged and the resulting average velocity multiplied by the total area of the air stream to find the volume of air per unit of time.

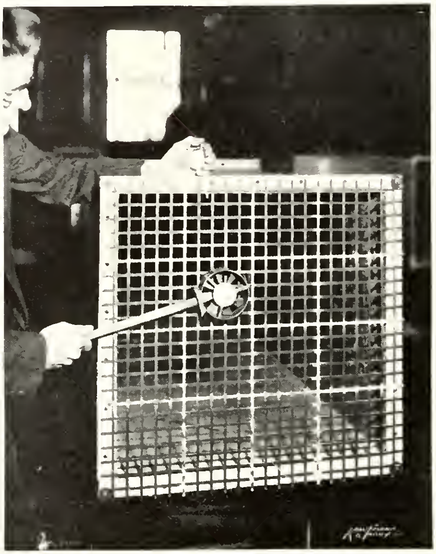

Fig. 1. Method of Taking Traverse.

As the air passes through a grille the flow is, of course, broken up into many small streams separated by spaces which may sometimes be as large as the streams themselves. The question naturally arises as to what effect this condition will have upon the anemometer readings. Several years ago a committee of the A. S. of H. and V. E. attempted to meet the problem in a rather arbitrary manner by establishing a rule that whenever an anemometer was used at the face of the register or grille, either one of two methods should be used. These two methods may be expressed by means of the following formulas:

$$Q = Va \qquad (1)$$

$$Q = vA \qquad (2)$$

in which

Q=volume of air.

V=average velocity of air as determined by anemometer readings taken with the instrument held in contact with the grille.

a=net free area of grille.

v=average velocity of air as determined by anemometer readings taken with instrument held 2 inches away from face of grille.

A=gross or total area of grille.

It was assumed the two methods would give the same results but it was soon found that this was not the case. In fact, tests made by the two methods gave widely different results, with Method "2" always showing the largest volume. Conditions reached a crisis when, within a short period of time, several large installations failed to be approved by the Chicago Department of Ventilation, who very properly, insisted upon using the conservative Method "1" until some other method could be proved to be more accurate. The interested parties finally agreed to submit the problem to the laboratories at the Armour Institute for solution, and the writer has for several months been engaged in conducting the necessary tests.

The equipment used in conducting the investigation is shown in Fig. 2 It consisted of a centrifugal fan delivering air into a 10" circular duct which leads to a short length of 24" square duct on the end of which a grille was mounted. The entire system was made air tight, so that the volume of air passing through the circular duct was known to be equal to the volume of air passing through the grille. Two pitot tubes were mounted in this round section so that the air flow could be accurately measured, at the same time that anemometer traverses were being made at the face of the grille. Tests were run using various velocities and various types of grilles as shown in Table No. 1. In each case two anemometers' traverses were made, one with the instrument held tightly against the grille, as shown in Fig. 1, the other with the instrument held a short distance from the face. The volume of air was then calculated by both Formula "1" and Formula "2" and the results compared with the correct volume as measured by the pitot tubes, to determine the percentage of error in each case. During the early part of the test the work was confined to supply grilles.

Table 1—Description of Grilles

No. 1

Expanded metal lath having diamond shaped openings measuring 2 inches by 0.932 inches across the corners.
Percentage of free area..........72.

No. 2

Plain lattice work:
Size of openings.... .95 inches square
Spacing—center to center...1.19 inches
Thickness .... 1/16 inch
Percentage free area 63.25

No. 3

Plain lattice work:
Size of openings... .875 inches square
Spacing—center to center..1.125 inches
Thickness .... 1/16 inch
Percentage of free area..........60.5

No. 4

Plain lattice work:
Size of openings.... .75 inches square
Spacing—center to center...1.00 inches
Thickness .... 1/16 inch
Percentage of free area..........56.25

No. 5

Plain lattice work:
Size of openings..... .50 inches square
Spacing—center to center.. .75 inches
Thickness .... 1/16 inch
Percentage of free area..........44.44

No. 6

Iron plate ⅜ inch thick round holes .73 inches diameter.
Percentage of free area...........38.2

The data obtained showed that Formula "1" gave indicated volumes that were from 13% to 40% too low. The largest errors occurred in all cases with the grilles having the smallest percentage of free area. The full significance of these results can be realized when one considers that in many cases the contractor would be required to install a system that would actually be 66% larger than necessary in order to have it accepted, where this method of test was to be used. On the other hand the indicated volumes as calculated by Formula "2" proved to be from 10% to 36% too high, with the largest error again occurring with the smallest grilles. With these two sets of figures differing by a minimum of 25% and a maximum of 116% it is not surprising that there has been endless controversy whenever tests of this kind have been run.

A careful study of the results obtained suggested to the writer the possibility of using a new formula:

$$Q = VAe = V\frac{(A+a)}{2} \tag{3}$$

in which Ae represents what we have chosen to call the equivalent area, equal in value to one-half the sum of the gross area and the net free area of the grille. The application of this formula gave most gratifying results. The maximum error in a large number of observations was 5% while the majority of the results were less than 2% in error. Even these small errors could be reduced by introducing a coefficient "C" in the formula, making it

$$Q = CV\frac{(A+a)}{2} \tag{4}$$

The value of this factor "C" does not appear to change with the type of grille but does vary slightly with the velocity. For most purposes a value of "1.00" will be sufficiently accurate, but for greater accuracy ".98" may be used, while for the maximum possible accuracy a value of "C" dependent upon the velocity may be selected from Table No. 2.

Similar tests were later conducted with exhaust grilles, that is, grilles through which air was being drawn out of the room. During these runs all observations were made with the anemometer held in contact with the surface of the grille as the nature of the air flow into an exhaust opening varies greatly under different conditions. Anemometer readings taken at any distance from the surface would be sure to be affected by the overall size of grille and the nature of the surrounding wall surfaces to such an extent as to make them valueless.

When the observed velocities were multiplied by the net free areas the resulting indicated volumes were found to be from 7.3% to 51.6% too low. When the new formula was applied in this case the results were less satisfactory than those obtained with the supply grilles, though very much better than the results secured with the old formula. It was found that in this case the results varied more with the velocity than they previously had done, and also that different results were obtained with different grilles. Taking the normal velocity range of from 150 to 700 feet per minute, the variation in the value of "C" in Formular "4" was found to be from .9 to 1.15 In other words if a value of 1.00 were used the results would be from 11% high to 13% low. However, the grilles with which the maximum errors were obtained were both types that would rarely, if ever, be encountered in practice, namely types No. 1 and No. 6. If these two types are left out of consideration the resulting error when using "1.00" for the coefficient, is from +3.2% to —10%. If a value of C dependent upon the velocity is selected from Table No. 2, the maximum error, considering all types of grilles, will be 10%, but in the vast majority of cases the results will be accurate to within less than 3%. Furthermore the 10% error will occur under conditions which would give 51% error with the former method.

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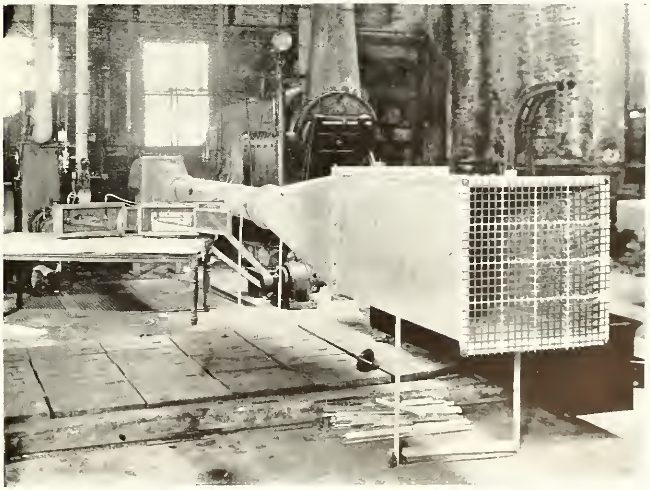

Fig. 2. View showing original setup of apparatus.

Chemical Agents and Their Application*

By Major A. M. Heritage

Chemical Warfare Officer, Sixth Corps Area

DO NOT let us forget our history, for, like the Bible, it contains too many interesting and profitable lessons which we cannot afford to ignore.

In reading about the Athenian Empire one finds that during the Peloponnesian War, when the Boeotian hoplites in the battle of Delium (Delion), 424 B. C., assaulted the Athenian fortifications, they used chemical agents in the form of charcoal and sulfur, burned in cauldrons to besiege the garrison. This written record establishes the early use of offensive chemical agents to be at least 2,354 years old, and while most civilized nations, at various times since, have declared against the use of these agents, when war comes along we find them playing a prominent part.

In 1899, on the initiative of the Tsar Nicholas II, the first Peace Congress at the Hague was held from May 18 to June 29 in the royal residence known as The House in the Wood, Holland. At this conference, which was attended by delegates representing all the civilized nations of that day, an agreement was entered into whereby all the nations represented, the United States excepted, pledged themselves not to use suffocating or poisonous gases. It is worthy of note here to pause a moment and consider one of the reasons why the Government of the United States did not support this agreement, namely: "It is illogical and not demonstrably human to be tender about asphyxiating men with gas, when all are prepared to admit that it is allowable to blow the bottom out of an ironclad at midnight, throwing four or five hundred men into the sea to be choked by water, with scarcely the remotest chance to escape."

At the time the United States entered the World War (April 6, 1917), chemical agents had been freely used for two years by the powers represented at the 1899 Hague congress. Again referring to our history we find that during the World War, while about one third of all our casualties (men put out of action, temporarily or permanently) resulted from the action of chemical agents, the loss of life, proportionate to the number engaged, was not nearly as large as in our own Civil War. Following the World War, it may be noted that the Washington Conference on the Limitation of Armament, 1922, adopted the treaty provisions prohibiting the use in war of "asphyxiating, poisonous, or other gases," as between the signatory powers, and other nations which might, from time to time, adhere thereto; however, the fact that not all nations are signatories to that treaty and the possibility of the future use of chemical agents by an enemy, make it essential that a knowledge of these substances be not forgotten.

Ship fumigation apparatus used in large scale tests.

Science increases the effectiveness of everything, including war, and the nation which leads in scientific developments, including chemistry, will have a big advantage over one less prepared. In chemical industry we find a plowshare most easily, simply, and economically converted into a sword, therefore, for an adequate "National Defense," we should have some agency to coordinate our industrial effort and to mobilize it in the defense of the nation, so that in time of a national emergency there will be less likelihood that anyone will seek to make war against us.

In an attempt to make clear just what is meant by the terms—chemical agent and casualty, the following is offered:

A chemical agent is a substance which when liberated in the atmosphere is capable, without force, of preventing one or more individuals from carrying out his or their mission either by placing a screen between him or them and the object sought, or by causing him or them to become a casualty or casualties. A casualty is a person or animal who or which is prevented from carrying out his or its mission. A soldier who is prevented from firing his piece due to tears coming into his eyes, is just as much a casualty as one who is prevented from firing his piece due to being shot through the hand.

As the ultimate mission of battle is to force the will of one body upon another, the weapon which will produce the greatest number of casualties with the least amount of destruction to people and property becomes the most effective, and, when the situation becomes one of self preservation, that weapon is the one according to all recorded history, that has always been employed.

Again referring to recorded history we find included among the chemical agents most everything from dust in the road to the most scientifically prepared arsenic compounds. In 1876, during the battle of the Little Big Horn, often termed Custer's Massacre, the Sioux warriors outnumbering three to one the Seventh U. S. Cavalry, put down or up, either way one wishes to term it, a "smoke screen" to obscure their movement and numbers. The Indians, not having an industry to manufacture modern chemical agents used, instead, the dust of the plains which they kicked up with the hoofs of their ponies. This screen, like the one used so extensively during the World War, prevented the white soldier from obtaining the correct enemy intelligence necessary for tactical success which resulted in the attacking force losing some 51% of its command including its commander, and won an overwhelming victory for the savage who knew nothing about chemistry from books, but did know something about the tactical value of the most plentiful of all chemical agents, the earth. Taking a lesson from the Indians, let us begin to realize the true value of chemical warfare which means the employment of smokes as well as gaseous substances, both toxic and nontoxic, which will cause many casualties with few deaths. When we do learn this lesson, then, we will also begin to realize that nations, with their backs to the wall, before becoming annihilated, will engage in chemical warfare during some period of their national existence.

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Fumigation of Ft. Hoyle bakery.

The peacetime use of some chemical agents employed during the World War may prove of interest to many. Chlorine is an element occurring in gaseous form at ordinary temperatures. It is important as a material which can be used to destroy the toxicity of other chemical agents. In every day life chlorine is used commercially mostly everywhere for water purification and as a cure for colds. It is made into bleaching powder (calcium oxychloride) for use as an oxidizing agent for bleaching paper pulp; as an intermediate in the production of chlorpicrin and as a destroyer of mustard gas. Chlorine and carbon monoxide in the presence of a suitable catalyzer react to form phosgene.

Phosgene is used extensively as a dye, medicinal, perfume, and flavoring extract intermediate. Another phosgene dye is wool-green-S made from phosgene, dimethylaniline, and betanaphthol. Thousands of tons of crystal violet and wool-green-S dyes are manufactured in the United States annually. It is also used in making synthetic coumarin, an ingredient of synthetic vanilla; in making methylheptic carbonate, the essential principle of synthetic essence of violet perfume; and the value of guaiacol, a drug used in the treatment of tuberculosis, is greatly increased by treating it with phosgene.

Mustard, which is not related to the mustard oil group, is in reality a sulfur derivative and called mustard due to its odor and blistering qualities. In the production of mustard, alcohol vapor is first converted to ethylene gas by passing through a column of kaolin fragments heated to a high temperature. The ethylene is bubbled through sulfur chloride producing mustard (dichlorethylsulfide). Mustard has a high boiling point (219.5 C.) and a low vapor pressure (.15 mm. at 86 F.) which makes it a valuable casualty producing agent when used to defend territory as it persists on the ground from one to thirty days. During the World War, mustard cost the American Expeditionary Forces about 271,993 days (man days) of fighting. The total days (man days) lost from all classes of chemical agents in the A. E. F. is estimated at 2,937,199.

Lewisite, an arsenic compound, is similar to mustard in its action, but is entirely different in its manufacture. It was isolated by Dr. Lee Lewis, chemical director, Institute of American Meat Packers, sometime professor of chemistry, Northwestern University, Chicago,—thus its name. It is obtained by passing acetylene through arsenic trichloride in the presence of aluminum chloride. It is a colorless to slightly yellow liquid when pure, but the plant product is usually dark green in color. This agent was not used during the World War, but the Chemical Warfare Service, during its investigation of methods for the control of the boll weevil, in which more than one thousand poisons and poisonous mixtures were run, found two arsenic compounds that showed a weevil toxicity, but did not cause any economic damage to the cotton plant. In addition to the boll weevil investigation, at the request of the National Research Council, early in 1923, the Chemical Warfare Service undertook the study of the effectiveness of poisons against marine borers which destroy docks and other water front structures to an estimated value of millions of dollars annually. As a result of the test of over one hundred compounds, it was found that organic compounds of arsenic, mercury, and copper had the best general toxic value against the various types of marine borers. Of the arsenics tested, those which were either chemical of warfare or derivatives of those chemicals were the most effective. A derivative of Lewisite, chlorvinylarsenious oxide, had the highest toxic value against the marine borers of any compound tried.

Chloracetophenone is a white solid, aromatic in odor, which produces tears copiously. As a lachrymator it has many uses, such as protection to safes, mob control, and police raids. As a commercial product, in connection with ship fumigation, a lachrymator has proved a most wonderful life saver. The Chemical Warfare Service, working in conjunction with the Public Health Service, developed a method of fumigation whereby cyanogen chloride, an intense war tear gas, is generated along with hydrocyanic acid. The compound is highly poisonous, so that the mixture is almost as efficient as hydrocyanic acid alone, and in addition, gives instant warning of its presence, even in sublethal concentrations. The fumigating mixture is generated by adding a mixture of sodium cyanide and sodium chlorate to dilute hydrocyanic acid. The fumigation is conducted chiefly to insure against the introduction of bubonic plague and typhus fever into the United States. Bubonic plague is transmitted to man from rats by means of the flea which carries the bacillus of the plague. The rats and their parasitic fleas are killed by fumigation. Typhus fever

(*Continued on page 154*)

The New Science

By Charles Link, Jr., '31

Student in the Department of Mechanical Engineering

ATOMIC physics is undoubtedly one of the oldest sciences known to man, although even to this day it has stubbornly protested against all attempts to pierce its resistive armour and drink of the world of facts within. While it may have been pondered over for many centuries, the science still retains its original luster and challenges other men to try their mettle.

Since the days of the early Greek philosophers, has man theorized on the mysteries of life and matter. Prominent among these early geniuses were Democritus and Thales, (420 B. C.), who proposed many of the fundamental ideas which form the skeleton of theory of matter today. At this early date, it became apparent to these men, after thoughtful investigation, that matter is identical in substance, consisting of groups of similar units arranged in various configurations. They further philosophized, that only these units, or atoms, and space exist, all else being mere opinion; that atoms are infinite in number and variety; and that nothing that exists can be destroyed. Although valuable as these theories may be when applied to experiment and calculation, they were scarcely recognized until about the middle of the last century when they were subjected to quantitative analysis. Physicists were seriously hampered in devising means of experimentally proving or disproving the validity of theories pertaining to matter, by the inability to see their objective. Also, the unaided vision is quite unreliable in quantitative analysis, although it greatly assists in the work; consequently, such devices as the Wilson cloud apparatus, the X-ray tube, Millikan's oil drop device, the cathode ray tube, the X-ray spectroscope, and many others, were designed to assist them.

While it is true that science and engineering have progressed remarkably under the handicap of a very limited knowledge of atomic physics, further study in the science will eventually yield benefits to civilization unheard of at present, in addition to stimulating a gradual improvement in existing processes and theories. Atomic action occurrences are so numerous, that one can scarcely cause a change of energy, a chemical action, an electric flow, or radio phenomenon to take place, without involving it in some way.

A practical and worthy contribution to civilization will be made, when a method is discovered to convert the potential energy of coal, oil, and gas, directly into electrical energy, without introducing such losses as are incurred in steam engines, turbines, and combustion engines. Known facts indicate that such a process is possible, but actual accomplishment awaits a more complete understanding of the atom itself. Wonderful improvements in the transmission of electricity may also be effected when the nature of matter is fully understood. Wild dreams of wireless transmission of electrical or atomic power, that have held the attention of several physicists for many years, will also be realized or proved impossible. Recent discoveries in astronomy, that matter, possessing a density of 400,000 times that of water, actually exists, suggests the possibility of a much more effective control of strength, weight, and other characteristics of metals, when their structure is known. The developments in radio and associated subjects would dwarf present accomplishments. And then, most spectacular of all, and those which symbolize the meaning of atomic physics to the average person, are transmutation of the elements and tapping of unlimited energy. The former would be the logical result of a more extensive discovery of atomic secrets, but the latter is rather speculative and developments may or may not fulfill expectations. Thus, from comparison of present accomplishments which resulted from considerations of atomic theory, to those possible in the future, the science is still new, and presents an opportunity for development that is unrivaled.

The first significant contribution to atomic physics was the Rutherford atomic model, introduced by that distinguished physicist, in 1911. Although this model of the atom failed to explain as many phenomena as those which preceded, it provided a foundation for later additions and refinements that rendered it suitable for modern applications. The atom, according to Rutherford, consists of a nucleus of relatively large mass, possessing a positive charge of electricity, surrounded by small bodies called electrons, which carry a negative charge and revolve about the nucleus in orbits. The number of electrons in atoms of any one element is the same, but differs from the number in any other

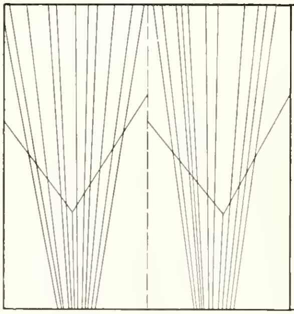

Fig. 1. Sketch of Blackett's photograph of a collision involving an alpha particle and a helium atom. Two mutually perpendicular views are reflected on one film to permit a calculation of the true angles of deflection.

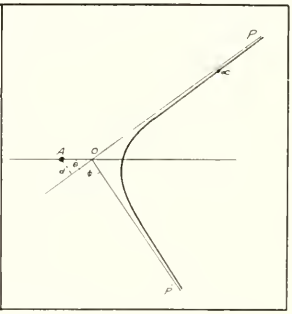

Fig. 2. The hyperbolic path described by an alpha particle when in vicinity of an atom. What appears to be a sharp digression from a straight line in Fig. 1 is shown to be a definite curve.

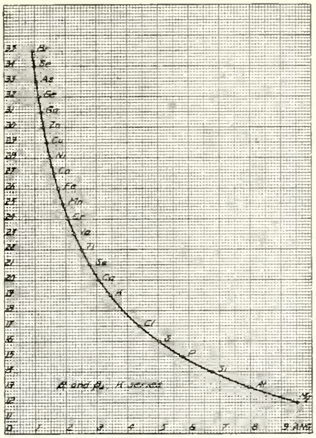

Fig. 3. A parabolic equation expresses the relation between atomic number and X-ray wave length. The curve shows that X-rays are directly affected by the number of electrons in the atom.

atom. A normal atom possesses as many negatively charged electrons as it does net positive charges in the nucleus, hence it is electrically neutral and will remain in that condition until acted upon by some external force. A fair conception of the size of the atom may be secured by imagining it to be magnified ten billion times,—a magnification that would enlarge a bird shot to the size of the earth, and cause the atom to appear a meter in diameter and the nucleus a tenth of a millimeter in diameter. The electrons revolve in imaginary spherical or ellipsoidal shells, in one of whose foci is the nucleus. The atom is thus mainly composed of empty space and resembles the solar system in many respects

The nucleus is believed to consist of an arrangement of positive and negative electrons, the mass of the former being 1845 times that of the latter, and so proportioned that the net positive charge exactly counterbalances the negative surface electrons. Atomic weight is associated with the mass of the nucleus, while atomic number refers to the number of revolving electrons. Chemical behavior and many of the physical properties, excluding mass, are determined by the arrangement of the surface electrons. Using this reasoning, Mendelejeff devised the periodic table of the elements, believing that various physical and chemical properties recurred because of the similarity of the pattern of the surface electrons with various atomic numbers. The relation shown to exist may not be as simple as indicated, but furnishes important material for consideration.

One of the most convincing proofs of the existence of Rutherford's atom is the scattering of alpha particles by bombarded atoms. An alpha particle is an atom of helium traveling at a speed about one-twelfth that of light, having been emitted by radioactive substances. By use of a method devised by C. T. R. Wilson, in which ionized particles, caused by the swift passage of an alpha particle, form the nucleus for condensation of water drops that reflect light and make it possible to photograph the track of the alpha particle, the result shown in figure 1 was obtained. Occasionally, the alpha particle will closely approach an atom of the gas in the bulb, and be deflected as shown by the sharp bend in the path. The struck atom will then become ionized, causing its path to be photographed as shown by the branch. The significant feature of the experiment is the relation which is found to exist between the number of electrons in the atom and the true angles between paths after impact. To obtain these true angles, Blackett took two simultaneous views of the impact at right angles and by geometrical means calculated their values. A closeup of what appears to be an actual impact between atom and alpha particle is shown in figure 2. The alpha particle, approaching the atom in the direction PO, is deflected by the electric field and follows the hyperbolic path to P. Knowing the angles theta and phi, it is possible to calculate the number of electrons in the atom at A. If the atom A is helium, the angle between the paths should be a right angle as confirmed by experiment and shown in figure 1. Having proved the formula for the special case of helium, in which there are two surface electrons per atom, the number of electrons per atom, or the atomic number, of many other elements may be found. Since the atomic numbers determined by the scattering method agree so well with other experimental evidence, Rutherford's atom must therefore be a reality.

Very important work on atomic numbers was done by Moseley shortly before the World War, in which he was killed. While trying to determine whether the physical properties of an element depend upon the atomic weight or the nuclear charge, by X-ray analysis, he found that the X-ray spectra of all elements are similar but differ in position. The difference in position is due to a difference in wave length or frequency of the waves which are emitted from the element of the target in the X-ray tube. Moseley found that the frequencies increased very nearly as the square of a whole number which varied by unity when the elements were arranged in order of increasing atomic weight, and identified this whole number as a measure of the nuclear charge and consequently the atomic number. With the aid of the scattering experiments which fixed the absolute atomic number in several cases, Moseley was able to assign a definite number to each element and provide for those as yet undiscovered. Since the electrons affect the proper-

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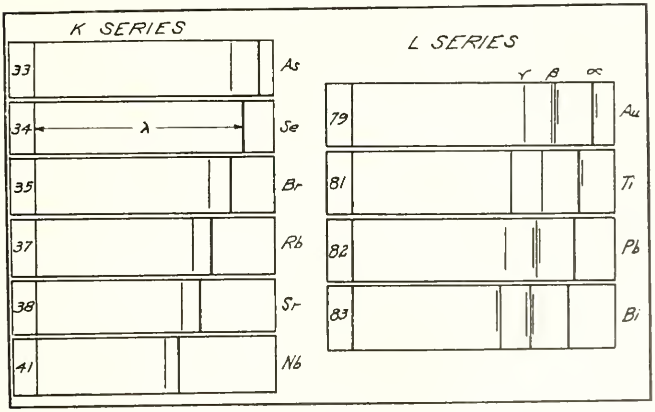


Fig. 4. The X-Ray spectra of all elements are similar but differ in position. The uniform variation of frequency of the X-rays between consecutive elements establishes the relative position of the elements in the atomic series

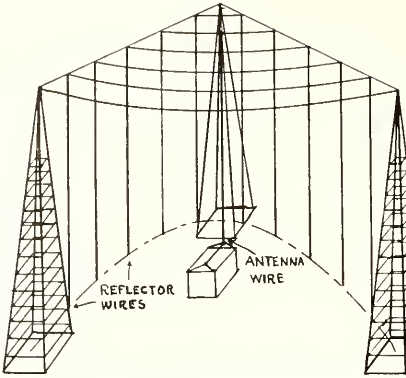


Fig. 1. Parabolic Reflector System.

High Frequency Radio Beam Transmission

By Morton Fagen, '32

Student in the Department of Electrical Engineering

"MAN is destined for progress, onward and upward forever." True or untrue as a generality, this prophecy is valid for the tremendous advances made in the realm of thought transmission. The march of telegraph, telephone, and wireless, each following on the heels of its predecessor, has taken an amazingly short time.

As its name implies, the beam system of transmission is a method for propagating radio waves in a specific desired direction. The "Broadcast" system is familiar to everyone for it is in this form that we know radio at present; the beam is its antithesis. The former may be likened to an incandescent lamp lacking a shade, distributing a more or less ineffectual light in all directions. Now an efficient reflector is placed over the bulb. The rays of light are concentrated into a strong beam which may be focused in any direction. Assuredly there are more possibilities for the harnessed rays emanating in the second case.

In the course of this paper, a treatment of directional transmission of radio waves as regards the following shall be made: (1) historical background and early experiments, (2) classification of the methods employed and a description of each, and (3) the results of their employment commercially.

The wireless beam is as old as wireless itself. Strangely, it had not been employed or even experimented with until the time of the World War. Like a pendulum, the work with radio began with the beam, swung over to a distinctly different branch, and completed its cycle with the revival of directional wireless in 1916. The period was sixteen years.

The classical experiments of Hertz and his contemporaries over forty years ago were performed on short electrical waves called high frequency radio today. Hertz conclusively proved that these waves obey the same laws as the waves of light in regard to reflection, refraction, defraction, and speed of propagation. He used a parabolic reflector of sheet metal in these experiments, securing a well-defined beam. Thirty-five years ago, by means of a high frequency beam, Marconi transmitted for a distance of almost two miles. In a paper read before the Institute for Electrical Engineers in London in 1899, he explained how it was possible by means of short waves and reflectors to project the rays in a beam in one direction only. He said, "When it is desired to transmit to the greatest possible distance and in only one direction, place the oscillation producer at the focus or focal line of a reflector directed to the receiving station, placing the receiving instrument in a similar reflector directed toward the transmitting instrument."

For the purpose of promoting interest in engineering subjects, Eta Kappa Nu, Honorary Electrical Engineering Fraternity, each year conducts an essay contest among the sophomore students in the Department of Electrical Engineering. The article contained herein was awarded first prize, and the writer was presented with a Standard Handbook for Electrical Engineers.

In 1901, Braun, a German scientist, applied for a patent wherein he described a reflector made of two series of parallel rods arranged above each other and in the form of a cylindrical parabola excited at the focus. In the following year, a patent by DeForest covered a reflecting system in combination with a series of wires extending in the direction of desired transmission. At this time, a regrettable tendency began to assert itself; the pendulum started its displacement.

With the methods employed in 1900, it was exceedingly difficult to produce short wavelengths of sufficient strength to be used practically. The development of long waves began with its tremendous effect on commercial radio communication. Because a long wave beam station is a constructional impossibility, it became necessary to neglect the directional work, and for sixteen years absolutely no advance was made in the field of high frequency beam transmission. Moreover, there was little call for directional systems at that time because the only practical application of wireless was that of communication to, from, and between ships at sea. For this use such a system was unnecessary, if not undesirable. For these reasons then, from the time of Hertz, up until 1916, there had been no practical application to wireless telegraphy of the beam system of propagation.

In 1916, Marconi was requested by the Italian government to work on the idea of utilizing beams of reflected waves for certain war purposes. The pendulum had returned. His experiments were made possible by the employment of vacuum tubes as oscillation generators, which had but recently been developed in England and America. With them he could secure a comparatively large amount of energy on wave lengths below twenty meters, a notable improvement over the spark and arc transmitters which were practically useless at these high frequencies. The experiments of 1916 showed that good directional working could be obtained with reflectors properly proportioned with respect to wavelength. In a beam patent filed shortly after these tests, Marconi claimed an increase in range of 500% over that obtainable with the same power using an ordinary antenna. In 1919 on a wavelength of 15 meters, speech was successfully transmitted for 78 miles. The great value of the beam was for the first time demonstrated by quantitative measurements which showed that the value of the energy received when reflectors were used was 200 times that of the energy without reflectors.

Much work was done in the following years and in 1922 a discovery of great importance was made. C. S. Franklin of the Marconi Company patented an antenna of novel construction which, as a director of radio waves, was superior to the parabolic system of reflecting wires. Known as the Franklin antenna, it is employed in all commercial stations of the Marconi Company throughout the world. At this point, it will suffice to say that in this arrangement, the antenna and reflector wires are disposed so as to constitute grids parallel to each other. Its effect was immediate.

New vigor was put into the experimental work. The foundations for a world-wide beam network were sunk. In 1923, with a power of twelve kilowatts, the Spain-Poldhu tests were carried out on 20 meters. Reducing the power to one kilowatt still gave signal strength in excess of that required for commercial traffic. With the 12 K. W. beam, the signals were louder than those received from the 300 K. W. stations at Carnarvon and Seafield. These were non-directional stations employing long wavelengths. Tests were carried out with the liner "Cedric," the yacht "Elettra," and stations in Australia. As a culmination of the activities in 1924, Poldhu was able to communicate with Sydney, Australia, for a period of 23½ hours out of 24.

Is it any wonder then, that Marconi was inspired to say: "The day is fast approaching when beam stations using short waves and employing only a fraction of the power utilized in the present high power stations, and with much lower and fewer masts, will be able to carry on communication at practically any time between any two points on the earth's surface, and at much higher speeds than are now possible."

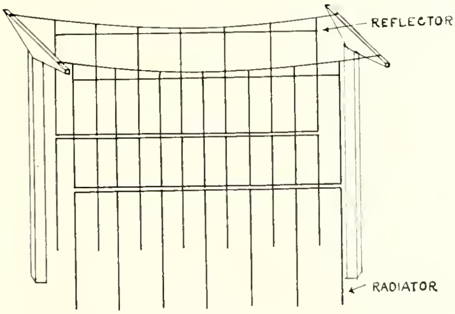
There are two general classes of directional aerial systems:

A. The first is those systems having the general characteristics of independence of directional power from their dimensions, the degree of opposition being a function of the direction. The simplest example of this class is the loop or frame aerial. The huge sacrifice of power attendant upon the use of such an antenna limits its use to rare instances.

B. The second class is those systems having the general characteristics of independence of directional power upon the dimensions of the system relative to the wave-length employed. This class consists of three divisions:

1. Reflector systems in general;
2. Systems composed of lines of aerials at right angles to the working direction, correctly adjusted as regards phase; and
3. Beverage long horizontal receiving aerials.

Group 3 is clearly confined to reception only. Moreover, the prohibitive dimensions of such an antenna render its use awkward. Groups 1 and 2 remain as the basis of beam radio. The reflector, it will be remembered, was the first type of antenna to be used in experimental work. The two members of group 2 are the Franklin antenna and an arrangement employed in France, the "French System."



The Franklin Antenna.

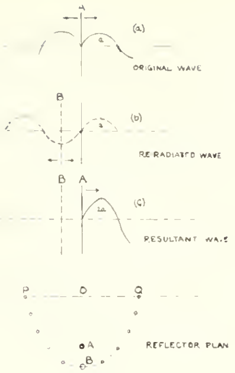


Fig 2.

Because of the dimensions of short waves it is possible to suspend a system of vertical wires to form a parabolic surface, and by taking advantage of phasing to concentrate and reflect radiant energy into a beam.

A straight conductor possesses distributed capacity and inductance and, when excited, forms an open oscillatory circuit whose natural wavelength is twice the geometrical length of the conductor. Assume a vertical wire ten meters long (A). Its response wavelength will be twenty meters. Upon excitation by any form of transmitter it will set up electro-magnetic disturbances in the ether and the electro-component may be depicted by sine wave symmetrically drawn (Figure 2a). If B is a similar wire set up five meters (1/4 L) to the left of A, the impinging wave front will set up oscillations in it. These will be 180° out of phase with those in A (Figure 2b). The re-radiation from B is shown by a sine curve exactly opposite to the wave from A at the instant of contact. Now to the left of B, the waves move in the same sense but are opposite in phase; therefore, they cancel. To the right of A, they travel in the same sense and are exactly in phase; they add. Thus, by placing a vertical wire behind the vertical transmitting aerial, the energy radiated outwards is doubled while no energy is transmitted in the reverse direction (Figure 2c).

Starting with one vertical reflecting wire, B, placed a quarter wave length behind the vertical trans-

(*Continued on page 156*)

The Jet-Wave Rectifier

By Thaddeus J. Dylewski, '30

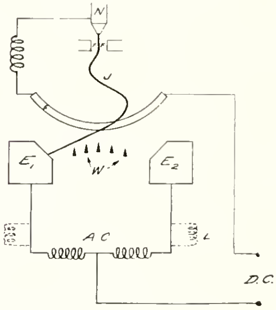
Student in the Department of Electrical Engineering

VERY recently a new type of rectifier of power size has been presented to the electrical world by Professor Jul Hartmann of Copenhagen. This rectifier may be classified as a mechanical vibrator type—since it uses a stream of mercury to perform the function of the vibrator. The action of this rectifier may be easily understood with the aid of the accompanying diagram. A jet of mercury, J, about 3 mm. in diameter, leaves the nozzle, N, with a moderately high velocity. A special tapping electrode, E, makes contact with the jet at all times. A winding on the transformer supplies the voltage A which produces an alternating current in the jet. A direct current field, F, reacts with the jet to transform its shape to that of a wave of constant velocity which alternately connects the tapping electrode E with the electrodes E_1 and E_2. If the wave is to be used for the rectification of an alternating current, the wave must advance half a wavelength during half the period of the alternating voltage. This is achieved by utilizing a current in synchronism with the voltage to be rectified, for producing the wave.

As the position of the main electrodes, E_1 and E_2, depends upon the velocity of the jet it is important that it be kept constant to within a few tenths of one percent. The jet is therefore produced by means of a reservoir and a nozzle, the level of the mercury in the former being kept constant by means of an overflow pipe. The maintenance of the jet naturally requires a pump in the hydrodynamic circuit.

For the production of the field an electromagnet is generally employed, the coils of which are outside of the chamber in which commutation takes place, the legs of the magnet being carried through the top of the chamber and insulated from the top plate. The current for the excitation of the magnet is taken from a direct current source, if available; otherwise, the magnet is fed from a small direct current generator which may be coupled to the shaft of the pump. With the coils taken outside of the commutation chamber, a temperature as high as 100° C. may be tolerated in the chamber and artificial cooling may be in many cases avoided.

With the jet wave rectifier, the commutation is accomplished by a transient arc. The arc is caused by the stray fields of the transformer, the effects of these two fields being the same as that of two inductances, L, inserted as indicated in the diagram. When the supply of the rectified current is changed from the left to the right hand side of the transformer, the energy stored in the left hand inductance must be dissipated and an equivalent amount of energy stored in the right hand inductance. The commutation arc is the direct result of this process, and has an important effect upon the efficiency of the rectifier, since an arc generally represents electric energy transformed into heat. On the other hand the spark has given rise to one of the main problems in the constructional development of the rectifier in that the cutting device must withstand the corroding effect of the commutation spark.



Method of connecting up the Rectifier.

The solution consists of using five tungsten knives placed as shown at W in figure. With five knives thus arranged it is possible to cut the jet in three places simultaneously. Obviously the use of spark gaps in series is the simplest and most effective method of stabilizing the commutation process. Recognition of this fact is likely to lead to results of great consequence. In the first place it is evident that the higher stability made possible will open up the way for rectifiers up to 1,000 volts or more. In order to commutate larger currents then can be handled by a single rectifier, two or more rectifiers may be operated in parallel. The jets of all of these may be fed from one reservoir, and the fields may be produced by one magnet. It has proved feasible to produce single rectifiers with two jets instead of one playing on the main electrodes of ordinary design.

Again, several rectifiers may be operated in series for the commutation of extra high voltages. Obviously, any number of rectifiers may be in series, and all the spark gaps of the combination will be in series at the time commutation occurs.

The electrode, E, is of unique design. It consists of two cylindrical pieces of steel on which sharp threads have been cut. The cylinders are then bent into arcs of a circle with a radius equal to the distance from the field to the electrode in its proper position. The two threaded shafts are separated by a gap through which the jet passes. The width of the gap is adjusted so that the threads will cut a few tenths of a millimeter into the jet. Under these circumstances there will, with the proper jet wave, be safe contact between an unimpaired wave and the electrode, and comparatively heavy currents of several hundred amperes may be passed from the latter into the wave. The deformation, to which the electrode gives rise, is relatively small.

The so-called six phase series rectifier consists of three rectifier units in series. The component rectifiers are generally mounted in a joint chamber. The chamber is kept filled with hydrogen because this gas alone is able to absorb the energy of the spark within the time available for the absorption to take place. The ratio of the duration of a spark in

(Continued on page 164)

ENGINEERING NEWS

The Automatic Viscosimeter

The recent marketing of an automatic viscosimeter has aroused particular interest in engineering circles, especially since this new instrument is the first devised for the measurement of the viscosity of Diesel engine lubricating oils. The readings of this device are recorded on a dial and can be read by anyone, whether or not he is familiar with the technical tests previously run. The standard commercial method of testing oils now followed is the Saybolt reading. The Saybolt test for viscosity requires a laboratory procedure entirely too difficult to carry out as ordinary commercial routine. A seeming lack of a feasible test for viscosity, therefore, has brought on the development of the automatic viscosimeter.

The instrument consists essentially of an ordinary pressure gauge measuring the head set up by an oil flowing through a friction tube, at a rate held constant by a diaphragm and ball check arranged somewhat as an ordinary reducing valve. The pressure exerted by the oil on the diaphragm regulates the valve opening. By the use of a spring device, the dial shows an appreciable change for a very few thousandths of an inch movement of the diaphragm. The diaphragm has a small calibrated hole through which oil can get underneath and from there to a calibrated outlet tube. The space between the diaphragm and the outlet is connected to a pressure gauge, the readings of which measure the tube viscosity with a considerable degree of precision. The instrument is provided with a standard pipe plug to permit its being tapped directly into the crankcase. The gauge is mounted on the same panel with the other pressure gauges, pyrometers, etc., regularly used for the safeguarding of the engine.

Contrasted with this new method is the Saybolt viscosimeter mentioned previously. This device measures the time required for a standard quantity of oil to flow through a standard orifice by gravity, so that the oil falls through under a variable head and the measured time required for the process is at best an arbitrary indication of the value sought. As a laboratory instrument the automatic viscosimeter should be a great improvement over the old Saybolt tester due to the great saving in the amount of time, labor, and skill required.

However, the real importance and value of the new device lies in the fact that its use should lead to a better understanding of the minimum value of viscosity with which it is safe to operate Diesel engines. An instrument that registers its readings on a dial will enable operators to correlate such essential factors as bearing wear and the condition of their surfaces with the true viscosity of the oils they are using.

Special Ladle Car for Hauling Molten Iron

Tons of molten iron are transported from furnaces to the rolling mills in Ohio in big ladle cars that resemble giant vacuum bottles. They are lined with fire brick and fitted with lids somewhat like those of the familiar containers. To empty them, they are tilted by an electrically operated mechanism, and the molten iron runs out like so much water. When filled, the car weighs about 340 tons. Its length is 56 feet. To prevent accidents, the tilting machinery can be operated only when the car is stationary.

Courtesy Popular Mechanics

Ladle Car for Hauling Molten Iron

Filter For Boiler Feed Water

It is necessary to eliminate oxygen from the boiler feed water, in order to check corrosion, not only in high pressure boilers, but also in those of low pressure. One means devised for the elimination of atmospheric oxygen from boiler feed water, makes use of a filter which employs manganese steel wool as the filtering medium.

Recently a large mining plant has made use of such a process quite successfully. Two filters were used in connection with nine double fire-tube boilers at 152 pounds per sq. in. pressure. They were supplied with river water superheated to about 50 or 60 degrees C. The water was then heated further by the exhaust steam from the boiler feed pumps. The boilers had been subject to slight corrosion due to the atmospheric content of the feed water. In order to do away with this unsatisfactory condition, a double filter unit was installed. It has a handling capacity of 1,060 cubic feet per hour at a pressure of 142 pounds per sq. in., and each filtering tank is about nine feet high and three feet in diameter. The two units may be operated singly or combined. The filter units can be lifted out easily and are cleaned out every two days to remove the ferric hydroxide. The inexpensive manganese steel wool is removed about once a year. In continuous operation the oxygen content of the water is decreased to one one-thousandth of the existing volume.

Aluminum for Threaded Parts

The use of aluminum, for engine parts and airplane apparatus, presents a vast field in which threaded aluminum parts are necessary. The defective characteristic of such parts has been their tendency to seize when threaded together, and in calling for such threads the designer must guard against this, unless the

(Continued on page 166)

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Make The Armour Engineer the best technical college publication in the country.

> *It is a favorite belief of mine that no student ever attains very eminent success by simply doing what is required of him: it is the amount and excellence of what is over and above the required that determines the greatness of ultimate distinction.*
>
> —*Charles Kendall Adams.*

THE DYNAMO LABORATORY—a collection of motors and generators of all types and description, the characteristics of which are tested by student engineers. Which will fit the job best? The Laboratory of Industry—an assembly of men of all types and description, who are tested by the Master Engineer. Will they fit in? Do they possess the necessary qualifications to do the work well? Will they get a chance to work at bigger, more important jobs; or will a different model, one of a later design, of a higher efficiency, of a greater speed, or of a greater capacity, be used in preference? Just as students test their machines, Industry will test these same students.

A synchronous motor will not start under its own torque, it must be helped up to a working speed. It must be pushed until it reaches its normal velocity before it can begin to work for itself. It cannot be hurried, it knows its pace and will not exceed it. At an overload it gives up, breaks down, and stops. Men too show these characteristics.

The induction motor takes its initial load with a grin, knuckles down on an overload, and is reliable and dependable at all loads. It is not capable of great spurts at increased speed, but is a great worker. Are these characteristics so far removed from those of some men?

The direct current motor is steady and reliable, a puller at the start, an efficient machine at full load, flexible, capable of adjusting its internal forces so as to increase its load with no loss of speed, and even responding to an emergency with a super speed. True, it is a bit high spirited, and capable of running wild if it does not receive the proper treatment, but a machine of great possibilities.

There are numerous special motors and devices, which do not fit in everywhere; they seem to be useless and a burden, but when their job is found, give results that are remarkable.

And so, most men, as most motors, have their peculiar characteristics, and fit in on some special job, and the Master Engineer, Industry, is forever searching and sorting, approving and condemning. Some men find their job, others never do, but keep working, giving the best that is in them, and never really giving complete satisfaction.

THE DISCOVERY of the new planet in the Solar System by the Lowell observatory on January 21, 1930 was the greatest astronomical event since the appearance of Neptune in 1846. To the world in general the announcement of the existence of this distant star came as a surprise, but to the scientists it primarily brought a substantiation of their theoretical conceptions.

In a no more striking manner could an example of clear thinking been put before the scientific and mathematically-minded people of today than by this discovery. It is common knowledge to the student of science, that every planet, every star, and in fact, every bit of matter in the universe exercises a pull on every other particle. From this as a starting point, scientists and mathematicians have worked for centuries, trying to place the various bodies of the planetary system so as to satisfy that basic law of physics.

With the aid of the telescope, astronomers were able to view the heavens about them and to ascertain whether or not their theories were correct. Refinements in the construction of the telescope were slow to come, but, nevertheless, at each step the star-gazers reached out further into space in an endeavor to find new worlds. They sought to correlate their mathematical findings with their astronomical discoveries. With each discovery more mathematical data was compiled, which dealt not only with the effects of the new planet or star, but also the bearing other bodies, some of them unknown, seemed to have upon it. In this way most of the invisible masses could be located, at least mathematically, in their correct positions.

As early as 1905, Dr. Percival Lowell predicted and mathematically demonstrated the existence of the planet found last January. For twenty-five years observatories have searched the skies so as to absolutely prove the presence of the body. Astronomers wanted once more to convince the scientific world that intelligent and consistent reasoning should precede the actual demonstration, and when it does, the results would bear out the initial findings. When at last it was actually proved that the new planet, which is approximately three billion miles from the earth, was a body in the universe, it was heralded as an astronomical epic that vindicated their efforts.

Science as a whole may point to this achievement with pride as an example upon which all its successful work is accomplished. Keen and precise thought coupled with patient research again was triumphant.

THE OHIO PRISON DISASTER.

On April 21, some 317 prisoners, inmates of the Ohio State Penitentiary at Columbus, Ohio, lost their lives in the most tragic prison fire that has ever occurred.

Prisoners are deprived of all civil rights; they are deprived of almost everything but a mere existence. They are locked in cells which, of course, deprives them of the privilege of self defense. They are entirely at the mercy of the prison officials. The fact that the prisoners are at their mercy is sufficient reason for the officials to be fully competent and assuming of the responsibility for the lives that are in their hands.

The evidence gathered after the disaster at Columbus shows that the heavy loss of life in the fire was due to carelessness and lack of proper safety precautions. The prison was unexcusably overcrowded; the buildings were in bad condition; there was a considerable amount of frame construction; and the fire started from a short circuit in electrical wiring. Witnesses in the case testify that there had never been a fire drill, nor had the prison personnel ever received instruction for routine to follow in case of fire. Testimony by the various officials indicates that contradictory orders delayed operations in freeing the prisoners.

From the point of view of the fire protection engineers, such a situation is caused by criminal negligence. They are continually striving for better conditions; they are endeavoring to teach the people the horror of fire, and methods of preventing it and protecting against it, when it occurs. Such disasters as the one at Columbus prove that the knowledge of fire prevention and protection of life and property is still in the primitive stages. A thorough knowledge and perfect conditions are only theoretical, and such a status probably can never be reached. However, cannot the situation be remedied? Cannot the necessity of providing safety in our public institutions be realized? Certainly, with the great numbers of lives lost in recent disasters, there should be a change in prevailing conditions.

There are many steps that could be taken. The necessity of constructing better buildings, of fire resistive construction can be stressed. The importance of removing certain hazards which may cause disaster can be shown. Organized fire drill can be made an important part of the routine of the institutions. As engineers, there stands out before us the grave duty of utilizing our technical knowledge for the betterment of mankind and the safeguarding of the present and future generations.

How Engineers View Life

Dr. C. E. Warne, Professor of Economics, University of Pittsburgh

In a machine age, the engineer plays an important role. Strategically located as he is, his opinions upon social institutions may dominate the trend of events. This brief summary therefore, is an attempt to see what engineers think of social reforms, how they view politics, what they think of free speech, how they look at the problems confronting women, what their attitude toward war is, and how they react toward the subject of religion. Obviously, this study, based as it is, upon the responses of a small group of Westinghouse engineers, will do no more than show some of the major trends. The group under consideration was trained in representative American engineering schools, but in order to prove this group as typical, a much more comprehensive study would be necessary.

Regarding the Distribution of Wealth.

An engineer representative of the majority of the group views the situation thus: "People are as a rule out to grab all the income they can. It seems therefore best for me to get my share rather than to envy those who possess wealth. I do not believe in the class struggle, though it is possible that there may be such. Ordinarily, poverty is the result of thriftlessness and inefficiency—on the whole the able and efficient go to the top and the less able sink to the bottom. The charity given to the weak and the unfortunate is not an attempt on the part of the rich to save themselves from a revolutionary struggle; it is rather the result of their kindness. By and large, a drastic re-distribution of wealth would result in the regaining of fortunes by their previous owners."

Regarding Labor Problems.

"On the whole, it is better that a worker have the right to work for any employer without interference from a trade union. Similarly, any employer should have the right to hire under any mutually agreeable terms. Wages should not be based upon needs—some other basis must be found. A wage system is necessary though it is probably true that each person working under that system does not get what he deserves. Sometimes, strikes do help workers increase their pay. Still, profit sharing is likely to prove one of the solutions of the "labor problem." It makes for common interests between employer and employee. Because unemployment is a mighty hard problem for the worker to handle, it would seem best that the employers or the state share in this burden. Our economic system isn't perfect; we must always look for defects in it."

Regarding Buying and Selling

"American capitalists receive and save so large a portion of the national income that the workers' share is inadequate to buy all the products produced by the enlarged plants. To have a bit less saved would not injure society, but it would release purchasing power into the consumption market. It is doubtful whether installment buying is good or bad; certainly, advertising does not live up to all the claims made for it—claims that it lowers the costs of goods and leads us to buy the right goods."

Regarding Politics.

"I believe in the American government. Our constitutional system is on the whole adequate to meet the strains which modern industrialism has placed upon it. Let's not tinker with it. Congress should not for example, be given the right to review the decisions of the Supreme Court. Nor should we have voting on the basis of one's occupation. Now, don't misunderstand me—I believe in the government but I do not feel that the Republican Party represents the best traditions of the American people. I'm for America. We should protect our country against possible invasion. Military training is, indeed, a good thing; it produces alert, stalwart, red-blooded youth. Still, we ought not to go in for too much preparedness. Having the marines protect the legitimate interests of American companies looks a bit doubtful as a practice If, however, we do get into a scramble it might be just as well to silence the pacifists or lock them up."

Regarding Ethics.

"Free speech is desirable; still this should not be taken as license to expound doctrines likely to undermine the foundations of the Republic or as a right to weaken the moral fibre of citizens. Especially should care be exercised to protect immature minds from subversive doctrines. Those labor agitators who stir up trouble and cause strikes ought to be locked up in jail or silenced. As for the rights of foreigners, this is the way it looks to me—if the natives do not use the great resources with which they are endowed, industrial nations perform a world service in opening up their country."

Regarding One's Own Occupation.

"I am doubtful whether there is any increase of human happiness in the world. Machinery appears to have been of great benefit—still I am uncertain. Probably, we could furnish more leisure time through the five day week and the six hour day, both of which appear practicable. Education is necessary and our educational institutions should teach us to be somewhat critical. On the whole, universities are doing a satisfactory job. Moreover the artistic world has a favorable outlook. Ancient art is excellent, but modern capitalistic influences in art are not undesirable. In all fields, changes are occurring. An international language would be a fairly good idea. Stock brokers and speculators are still a problem and are getting incomes without rendering a service. Nevertheless, production is ever mounting. Let us keep a healthy optimism.

COLLEGE NOTES

Tau Beta Pi

On Friday, April 11, the members of Illinois Beta chapter of Tau Beta Pi, pledged the following juniors: A. B. Auerbach, A. F. Wilde, R. M. Krause, W. E. Schirmer, B. S. Lindquist, A. J. DeLong, and W. Drigot. These men were initiated on May 6, and a dinner at Coffee Dan's, followed.

Sphinx

Sphinx Honorary Literary Fraternity chose men from each of the publications on the campus who, by their work have shown that they have ability and interest in the field of journalism. From the Cycle staff were chosen A. H. Jens, O. R. Murphy, R. A. Timmermans, and R. N. Wilson. For work on the Engineer the following men were pledged: A. J. Lenke, C. T. Link, I. G. Katz, and J. H Stranberg. The News pledges were K. A. Knittel, A. F. Wilde, A. B. Auerbach, and F. B. Attwood.

Phi Lambda Upsilon

The honorary chemical fraternity held a smoker Tuesday evening, March 25, at which time they pledged I. G. Katz, '30, and M. Yzaguirre, '31.

Pi Tau Sigma

The mechanicals pledged two men to their honorary society at a smoker held at the Triangle house on Thursday evening, April 3. The men were R. H. Stevenson, '31 and R. N. Krause, '31.

Chi Epsilon

The Armour chapter of the honorary civil engineering fraternity selected six men out of the junior class for pledgeship in their society. The men were Leonard Dicke, Karl Hellsen, Eldon Johnson, Bert Lindquist, B. G. McLaughlin, and C. J. Robin.

Eta Kappa Nu

The electrical honorary has pledged five juniors, C. Blahna, W. Penfold, H. S. Marando, E. S. Warner, and A. R. Draus for the spring term. The pledging smoker was held in the H. K. N. rooms. An inquisition smoker was later held at the Beta Psi house at which time the prospective pledges had the opportunity to meet members and alumni.

Salamander

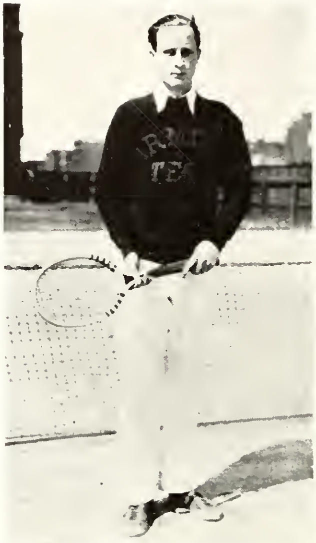
The Fire Protects selected four men from the junior class who had shown by their scholarship and school activities that they were deserving of membership in the Honorary Fire Protection Engineering Fraternity. These men were F. S. Austin, A. J. Lenke, W. E. Schirmer, and P. E. Seidelmann.

OUR VARSITY CAPTAINS

Tennis

Albert Winkler, M. E., '30

The tennis team, this year, has suffered more this year than any other team, through the loss of Jennings, Stellar and Lamb, who were the backbone and spirit of last year's team. However, with the assistance of Coach Colvert, and Manager Manske, Captain Winkler hopes to develop a team somewhat in keeping with those of previous years.



Al Winkler started to play tennis at an early age, practicing hard on the clay courts of Washington Park. Here he developed his game, and after entering Lane Technical High School, where he received his prep school training, his hard work was rewarded. His ability on the courts, won for him a place on Coach Umbreit's team for three successive years, the last of which he acted not only as Number One, but also as captain and manager. As Al entered Armour in February, and could not acclimate himself to the Institute, he did not respond to Coach Tibbals' call for candidates that year, but he has since successfully maintained a position on the team. Slowly he has increased his rank from fifth to first, and was captain this season. He was a big factor in winning the Interfraternity Tennis Trophy, donated by the Armour Athletic Association, for Phi Kappa Sigma Fraternity, of which he is a member.

Captain Winkler has earned his letter in tennis, and is a member of the Honor "A" Society. He is now a senior and will graduate this year.

A. I. E. E.

The Armour branch of the American Institute of Electrical Engineers, in the latter part of February, decided to feature student talks at the meetings instead of having outside speakers. As a result, four excellent talks have been given by members. C. E. Rudelius gave a talk on "Street Lighting in Hammond, Ind." and H. E. Stier gave a talk on "The Application of Electricity to Ballastics." At the following meeting, Frank Sanborn spoke on "Electrical Refrigerators" and J. Taylor spoke on "Electric Tabulating Machines." The speakers drew on their own experiences for most of their material and added a personal touch to the talks that made them very interesting.

Speakers from outside also contributed interesting talks before the Armour branch. Mr. A. J. McMaster, research engineer for the G-M Laboratories, spoke on the construction, characteristics, theory, and applications of the photoelectric cell. On April 17, C. D. Miller of the Curtis Lighting Co. spoke on "Color Lighting." By means of slides and actual demonstration he showed the members the new uses color lighting were being put to in the field of illumination. He spoke especially of a novel device, the Lumitone, that when played like an organ would produce many color effects.

The members of the Armour branch joined with members of the Chicago Section in a banquet at the Sherman Hotel on May 14.

A. S. M. E.

The Armour branch of The American Society of Mechanical Engineers has been very active during the last few months. The members have shown an interest in student talks and, as a result, many interesting ones have been given. On April 3rd, M. Vander Velde, '30, gave a talk on the construction of elevators and the safety appliances used on them. T. O'Malley, '30, followed with a discussion on gas engines.

The fiftieth anniversary of the founding of the A. S. M. E. was held April 8th, in the Red Lacquer Room of the Palmer House. The affair consisted of a banquet and dance, with a short talk on the history of the society given by Mr. H. S. Dickerson, chairman of the Chicago section. Armour was represented by H. H. Stebbins, C. Rambolt, and A. J. Frost.

The annual Spring smoker was held on April 10th at the S. K. D. House. Mechanicals from the senior, junior, and sophomore classes attended, as well as Mr. Dickerson and members of the faculty.

At a meeting on May 1st, R. Krause, '31, and R. Stevenson, '31, gave short talks on engineering subjects. H. H. Stebbins, president of the society, thanked Professor Roesch and R. Spencer, '30, for their advice and assistance in arranging meetings during the past year. Election of officers was then held with the following results:

Professor Roesch	Honorary Chairman
C. T. Link	President
R. H. Stevenson	Vice-President
R. W. Krause	Secretary
F. F. Strassenburg	Treasurer

W. S. E.

The Armour Branch of the Western Society of Engineers had the opportunity to hear Mr. E. D. Lord, engineer for Holabird & Root, architects, talk on "Construction Details of the New Board of Trade Building." He brought a model of the building and told of how the stock pit was built. It is a large room with the ceiling 57 feet from the floor and with no supporting columns. Instead, nine huge trusses, two stories high, support the ceiling and the rest of the building above.

The members enjoyed a smoker given April 24 in the W. S. E. rooms in the Engineers' building. Entertainment was furnished by pledges of Chi Epsilon, who gave a play that had been written by last year's pledges.

F. P. E. S.

The Fire Protection Engineers' Society have obtained for their regular bi-weekly meetings, speakers who are authorities on their particular line of fire protection work. They bring information that is interesting and helpful to all of the members.

Dr. D. S. Michaels, head of the Burglary Department of the Underwriters' Laboratories, spoke March 5, on "Burglar Protection," explaining the various automatic methods of detecting a burglar. Mr. H. G. Casper, assistant manager of Fred S. James & Co., general agents, explained the fire insurance business from his company's standpoint at the meeting held on March 19. Mr. R. E. Vernor, manager of the Fire Protection Department of the Western Actuarial Bureau, spoke April 2, on various phases of fire protection, explaining the causes and the far reaching effects of fires. Mr. Leonard Peterson of New York, who is special agent for the Home Fire Insurance Co., spoke on "Use and Occupancy Insurance," and on April 30, Frank Erion, Insurance Adjuster, spoke on "Adjusting the Fire Loss."

A. I. Ch. E.

The activities of the Armour branch of the American Institute of Chemical Engineering during the spring period have resulted in a smoker and several interesting meetings. On March 21 they secured Mr. L. C. Cooley, Chemical Engineer for the Whiting Corp., to speak to them on the engineering problems dealing with the design of evaporators. The members were given the opportunity to learn about chemistry in warfare through a talk given them by Major Heritage of Chemical Warfare Service of the U. S. Army. The subject of his illustrated talk was "The Relation of the Chemical Industry to the Manufacture of Chemical Warfare Agents."

The Armour branch held a smoker at the Phi Pi Phi house on April 9. Novel entertainment was furnished by songs and poems given by members, while cards and refreshments filled out the program. Almost all of the freshmen chemicals attended.

Senior Electricals Visit Underwriters' Laboratories

The senior electrical inspection trip of March 5, was made to the Underwriters' Laboratories, at 207 E. Ohio St. Underwriters' Laboratories is housed in a model fireproof building where all the latest improvements for protection against fire are not only advocated, but are actually used. Here, the use of fireproof material is shown to be practical in producing a building of modern and artistic design. The doors and trim are all of metal, the floors, walls, and ceilings are composed of fire resisting material, and the windows are placed in steel frames, protected by metal shutters which close automatically when the temperature reaches a certain point. No part of the building itself is composed of wood.

On entering the building the Senior Electricals were conducted to a meeting room where they listened to a talk by Mr. Bunker, explaining the purpose of the Laboratories, the growth of the institution since it was started, and the methods used in listing the articles which have successfully passed the fire tests. The Underwriters' Laboratories is an organization which is not operated for profit, its sole purpose being to work in conjunction with the insurance companies in determining fire hazards in different classes of buildings. The causes of fire, and the factors which govern the spread of fire, are studied. The Laboratories test household appliances, fire extinguishing equipment, fire doors, roofing materials, building materials, fire proof safes, oil burners, and all other articles pertaining to fires or which may possibly become a fire hazard.

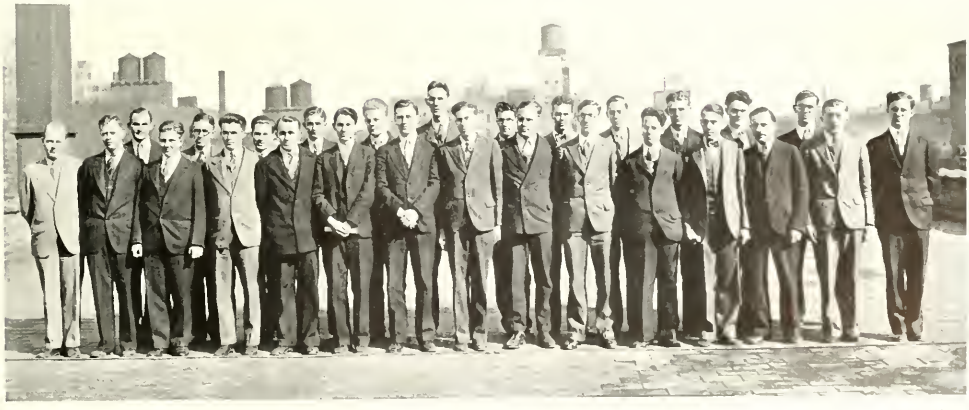
The trip through the various departments proved to be exceptionally interesting to the Electricals. The first section visited was the oil burner department where new developments in oil burner units are tested under every possible operating condition. Over 125 different makes of burners have been listed and labeled by Underwriters Laboratories.

Building columns are tested in furnaces under pressures up to 200 tons, these pressures being obtained by means of a hydraulic press. One of the duties of the fire protection engineer is to inspect sprinkler heads and to send samples to the Laboratories where they are tested. Very severe tests are placed on fire doors and window shutters. They are placed in an oven and are heated for one hour, at which time the temperature has reached 1,700 degrees Fahrenheit. At the end of the hour the red hot door is subjected to a stream of water from a fire hose, and in order to successfully pass the test, it must not show signs of cracking or warping.

Other important features were the chemistry and physics laboratories, where the properties of the rubber in fire hose and of other materials used in the construction of apparatus, are determined.

Electrical equipment is often the cause of fires, so it is thoroughly tested in the electrical department. Motors are tested in an atmosphere of dust; switches are opened and closed under full load a specified number of times; and fuses and circuit breakers are tested under various loads.

At the Underwriters' Laboratories the fire protection engineers attempt to show that fire prevention and fire resistance are matters of applied science.



The Senior Class in Electrical Engineering, Accompanied by Professor Moreton, Making an Inspection Trip through Underwriters' Laboratories, March 5, 1930

Baseball Team Again Promises A Successful Year

For the third consecutive year, Armour's baseball team continues to pace ahead of the surrounding college teams. The 1928 season found the Armour team victors in ten of the fifteen games played. Last year they established a record of twelve victories and only one defeat, while this year they have already annexed five victories; having suffered but one defeat in the early season.

Armour inaugurated the opening of the ensuing season with a 6-1 victory over Morton College. On April 14, Armour fell before Notre Dame, 11-4, in a game that was marked with numerous errors. On April 17, Armour annexed its second win by nosing out De Kalb Teachers' College 4-3. The team almost added its third victory on April 23, when they met the Y. M. C. A. College at the home field, only to be rained out in the fourth inning, after enjoying a 4-1 lead.

Lake Forest College was the next victim. Armour encountered that well reputed nine on April 26, at Lake Forest, tucking away a 6-3 win. On May 2, and 3, Armour met two of the most dangerous teams on its schedule and subdued both. The game on May 2, was won from Western State Normal at Kalamazoo, Michigan, 5-4, and on the following day Armour travelled to Ypsilanti, Michigan where they defeated Michigan State Normal 8-5.

The Baseball Team—1930

Left to right: Front row—Reichle, Robin, Capt. Simpson, Weldon, Mago, Anderson. Second row—De Orio, Cannell, Hauser, Miran, Pepe. Third row—Mgr. Short, Link, Sommers, Michalski, Stehno, Rowley, O'Connor, Coach Krafft.

The opening game with Morton gave evidence of Armour's prowess and foreshadowed the team's possibilities for the remainder of the season. Stehno and Simpson did the hurling for Armour in this game. These men allowed Morton but three hits and struck out eleven of the opposing batmen.

Throughout the remaining five games Stehno and Simpson continued their effective pitching. Coach Krafft split the pitching assignments between these hurlers in order to avoid overtaxing any one pitcher. King Simpson's peerless brand of baseball enabled Armour to cut the innings short with strikeouts, while Stehno's good contribution of strikeouts and infield putouts helped Armour to keep well in the lead.

DeOrio, our sturdy backstop, made his first appearance, in Armour's baseball toggery, in the Morton College game. DeOrio's excellent performance won him a regular berth with the squad and insured Armour of keeping the stolen base count to a low mark.

The game with DeKalb Teachers' College gave evidence that Armour was effective in the pinches and was able to take advantage of every scoring opportunity when the game hung in the balance. Although out-hit 9-4 in this game Armour came through with a 4-3 victory. Bud Weldon's two-base hit in the sixth inning cinched the victory. Aside from contributing an occasional hit, Weldon has helped the team considerably with his excellent fielding performance.

Tennis Team Faces Tough Schedule

Armour's 1930 tennis team, unlike the much heralded teams of past years, is experiencing a discouraging season. To date, the racket men have entered into competition against four teams and have lost all of the meets. Lake Forest conquered Armour 4-2, Loyola scored a 5-2 victory, while Notre Dame and Y. M. C. A. College have each registered 6-1 victories.

Armour's present team is greatly weakened by the loss of Jennings and Stellar, last year's star performers. Despite the absence of these men Armour had drawn up a hard schedule consisting of return matches with the teams mentioned and in addition will meet St. Viator of Kankakee, Valparaiso, and DeKalb.

Several of the members appear to be able court performers, but owing to the hard schedule that confronts them, they face but little possibility of coming through the season with a majority of victories to their credit.

Among the men that form the Armour roster are Winkler, Eddy, Scott, Schirmer, Spencer and Timmermans. All of these men have registered individual victories or have won in all the doubles against opponents of other teams, but on no occasion have they won a majority of the sets in any one meet. Dr. C. A. Tibbals who coached several teams of championship caliber, resigned at the beginning of the season when he found that he would not have sufficient time to devote to coaching. His place has been filled by Prof. Colvert, who will do his best in helping the team as much as possible.

George Jennings, ex-captain, is back at school again and although he will not play on the Armour team, will undoubtedly be heard from. George will try out for a place on the 1930 Davis Cup team which this year will be composed of men who have had little or no experience in international play.

Junior Week

As usual Junior Week was a busy time for everybody, although this year it seemed especially so. The activities were many and varied, and the events were of interest to all.

Monday, May 12, was the opening day of the week. In the afternoon the alumni met the varsity in a baseball game, winning the game only after a hard fight. In the evening "Open House" was held in all the buildings of the Institute. The civil, electrical, chemical, mechanical, fire protection, and architectural departments all displayed evidences of their efforts in a highly instructive and illustrative manner. Several commercial firms aided by furnishing recently developed products as part of the exhibits.

On Tuesday the Armour track squad and the tennis team journeyed to Loyola, where they met that school in competition. The following day a ball game between Armour and Lake Forest was held on Ogden Field.

The inter-fraternity track meet and a tennis match were the interesting features of Thursday's activities. The track meet was run off at Ogden Field, while the Armour courts were the scene of the battle between the Valparaiso and Armour tennis teams.

On Friday morning the inter-class relay, the pentathlon, and the inter-fraternity relay were run. In the afternoon the Freshman-Sophomore Rush took place, and directly after that the various social fraternities put on their circus stunts. The Junior Prom was held during the evening, and this event closed the busiest day of the week.

Saturday, May 17, was the final day of Junior Week and the attraction was another baseball game, this time between Armour and Y. M. C. A. College. The game was played at the University of Chicago.

Open House Draws Large Crowd

The annual open house night was held on May 11, with the object of displaying to those interested in the Institute some phases of its curriculum.

In the physics laboratory, special experiments of interest were undertaken and described. A gaseous discharge tube produced attractive phenomena for the edification of the audience. In addition, a number of the routine exercises were carried out as they might have been in a regular laboratory period. In the radio station, the methods of radio telegraphic communication were explained. In the chemistry laboratory, regular analyses were conducted by a number of students.

These were but a few of the activities throughout the buildings. Relatives and friends of Armourites were shown in a general way, the great practicality of the Institute's courses.

The Armour Alumnus

VOL. V | *J. Warren McCaffrey, '22, Editor* | No. 4

Dr. O'Grady Plans for Remodelation of Natal

Aims to Make City Most Progressive in Brazil

Again we hear of Hon. Dr. Omar O'Grady, '17, Mayor of Natal, who has done so much for that city. O'Grady has been personally responsible for Natal's growth and prosperity in the last few years. Now he plans to do even greater things and to make the city the most progressive in Brazil. Quoting from the Brazilian American, the Business Builder Magazine of Brazil, "Great publicity has been given to the 'Agache plan for the remodelation of Rio de Janeiro' and an impression has been created that this is the only systematic scheme which has been worked out by Brazilian cities. Natal, however, due to its enterprising mayor has elaborated the 'O'Grady plan,' which will make the city one of the most attractive of modern cities as well as thoroughly efficient aerial and maritime port.

"Some six years ago Dr. Omar O'Grady, a graduate of the 'Armour Institute of Technology' of Chicago, was elected Mayor at Natal, Capital of the State of Rio Grande do Norte and courageously undertook the transformation of a typical drowsy tropical city in a picturesque setting into a bustling city equipped with efficient public services.

"Dr. O'Grady has had the foresight to realize that Natal, owing to its unique, geographic position is destined to play a prominent part in international commercial aviation, not only between North and South America but also on the Europe-Africa-South America route. This feature, which is already radically altering the status of the city, has been carefully considered in the O'Grady plan."

Hon. Dr. Omar O'Grady,
Mayor of Natal

Annual Alumni Banquet Tuesday, May 27

Plans have been completed for a real alumni party which will be held on Tuesday evening, May 27, at the Bismarck Hotel. This party promises to be different because there will be no speeches but in their stead a variety of interesting features. First of all, the orchestra from school will be there to liven things up, the star athletes will be introduced, the students who have brought credit to themselves and the Institute by their efforts in collegiate competitions will be present, Professor Amsbary will entertain and several other features are added to make this annual alumni banquet a real alumni party.

The time set for dinner is 6:30 P. M. and the management promises us something extra for our two and one-half dollars in the way of food. It was decided to hold this party at the Bismarck Hotel because they are noted for their good food and Otto Eitel, the manager, is himself an alumnus.

Don't forget the new place, Bismarck Hotel, on May 27, for a real live alumni party with your friends of the faculty and classrooms.

Prof. Daniel Roesch Writes Airplane Book

Professor Daniel A. Roesch, '04, of the Mechanical Engineering department has just published a book, "Airplane Engines." The book contains a description and explanation of the Gnome, Hispano-Suiza, Liberty 12, and Wright Whirlwind motors. The book was prepared to be used in connection with a Theoretical or Practical Mechanics' Course. Most of the information presented is a result of the experiments and studies of these motors that have been carried on by Professor Roesch.

Dr. Louis C. Monin has changed his address from Dufourstrasse 30, Zurich, Switzerland, to Gladbachstrasse 71 in the same city.

W. Oldenburger, C. E., '14, who is now in charge of the affairs of the Pilot Radio and Tube Company in Mexico City, has recently completed arrangements for an airplane tour of South and Central American cities in the interests of radio developments.

Pease Finds Largest Star

Francis G. Pease, '01, recently found the largest star known at present.

With the new instrument to be put in use stars larger than any now known may soon be found by astronomers at the Mt. Wilson Observatory. It is known as the fifty-foot interferometer, and consists of a steel "bridge" 54½ feet long on which move mirrors to pick up the light of a star.

Mr. Pease used a smaller instrument of the same type, attached to the 100-inch telescope, the world's largest, to find this new star. It is called Antares, in the constellation of the Scorpion, and is large enough that if it were hollow it would hold the solar system with the earth and other planets out to Mars, with 55,000,000 miles to spare on all sides.

Ralph W. Emerson, '27, has been doing much of the architectural work for the coming World's Fair. He is employed in an architect's office here in Chicago.

Classmates Join New York Club

An issue of the "Club News," published and distributed by the American University Club of New York City, was sent to the Alumni Office recently. Its pages disclosed the fact that two graduates from the electrical department in 1905 are still closely associated, having passed from classmates to club members in the above named club. They are John Howard Payne and Oscar A. St. Clair.

The same magazine informs us that both gentlemen have different positions than our alumni records showed formerly. Mr. Payne is now with Westinghouse Electric International Co., which is a subsidiary of the company he had been a manager for. Mr. St. Clair is no longer with Beavers Products Co., but is now Chief Engineer of Atlantic Gypsum Products Co.

Clifford A. Beekman, '27, is now with Sears, Roebuck & Company, as othe technical director.

Baldwin Elected President Architectural Sketch Club

Francis M. Baldwin, '21, was elected president of the Architectural Sketch Club of Chicago, at the recent annual meeting.

The board of directors of the club includes another alumnus of Armour Institute, T. M. Hofmeister, '21.

T. A. Hicks, '06, visited school last Friday, spending some time in the mechanical engineering department. Since leaving school in 1904, Hicks has been connected with Westinghouse Electric Company at Philadelphia. At present he is travelling through the midwest, inspecting rail cars which have Diesel electric drives.

Henry Eickelberg, M. E., '23, visited his former instructors last week and inspected the laboratories. His home is in Oak Park, Ill., and he is the owner of two garages on the West Side of Chicago.

M. B. Krebs, '23, who is now with the Commonwealth Edison Company, and R. S. Illg, '20, who is with the Illinois Bell Telephone Company, are attending Professor Freeman's evening school class of Economics at the Western Society of Engineering rooms.

Phil Diwert, '28, visited Chicago and the Institute last week. He is with the Indiana Inspection Bureau and located in Indianapolis.

R. J. Reed, '28, and John William Gamble, '29, are working for the Indiana Inspection Bureau. They can be communicated with by writing in care of the Bureau in Chamber of Commerce Bldg., Indianapolis, Indiana.

Stopping in one of our modern sandwich shops the other day we were pleased to see S. Alan Baird, '25. He was happy and working overtime on his work with J. B. Lund, consulting engineer at 189 W. Madison Street. We were advised that his happiness was due to the arrival of a son about the middle of February. Our suggestion to Baird was that he put in overtime at home with his wife and boy.

Henry W. Clausen, '04, was seen in the vicinity of school the other day, looking over some of his old time haunts. He is now engaged as one of the executive heads of the C. D. Osborn Co. at 2201 Wabansia Ave.

Word has been received from Arthur T. Millot, '27, that he is happily engaged with the General Electric Refrigerator Co. He may be reached at the office of the firm at 2120 S. La Salle St.

George Strom, '29, is working in Gary, Indiana. He is employed at the Gary Steel Mills.

The Chicago, Milwaukee, St. Paul and Pacific Railroad now has Charles Craig, '29, on its payroll. Charley is located in Chicago and is designing buttresses used in the elevation of tracks.

Alumni Architects Design Thompson Restaurants

John R. Thompson Company are planning to start working June 1 on three new restaurants, two of which will be in the loop. The architectural firm of Loebl, Schlossman and Demuth will supervise and plan the work for all three.

These three alumni have been architects for a number of good size and distinguishable pieces of work since they formed the present partnership a little over a year ago. Demuth graduated in 1922 and both his partners in 1921.

He Will Succeed

He will succeed who gives his best
To every task and every test.
He will succeed who day by day,
Plods steadfastly along his way.
For him the lights of fame shall burn
Who never grows too wise to learn.
Who rises with the morning sun
Intent on bettering what he's done.
Who asks no favors from the past,
Believing yesterday should last.
He will succeed who understands
Life has no place for idle hands.
Who rightly all life's history reads,
Big men have always done big deeds.
He will succeed who truly knows,
That merit often slowly grows.
He will succeed who'll work and wait,
And seek the knowledge of the great.
He will succeed whate'er his birth,
Who has the pluck to prove his worth.

—*Edgar A. Guest.*

Alumni Beat Varsity in Fast Ball Game

On May 12, the alumni met the varsity baseball team in their annual game at Ogden Field. It was only after a tough struggle that the "grads" were able to come out on the long end of a 7 to 5 score.

John Yount, '29, did the pitching for the alumni and was quite effective in the pinches. Sydney Cannell, a sophomore, was the pitcher for the varsity.

Joseph McLaren, '26, passed through Chicago the other day. He was on his way to Iowa where he will begin work for some insurance company. Previously he had been with the Ohio Inspection Bureau.

Cal Johnson, '29, is now employed at the Underwriters' Laboratories here in Chicago. He has charge of the junior fire protection engineering students in their work at the laboratories.

Word has been received from Packer Brown, '29, who at the time was in St. Louis, Missouri. Brown, who had been working for the Simonds Co. here in Chicago, is now engaged in doing sales' engineering work.

Open House at Armour Finds Many Alumni Back

At the annual Open House activities on May 12, many alumni were at the Institute to view the exhibits. James D. Green, '27, former business manager of the Armour Engineer and now with the American Bridge Co. at Gary, Indiana, was present, as also were Myron Golber, '29, of Armour and Co. and Gerhard Freundt, '29, of the American Can Co. John Brady, '29, was another interested spectator.

One of the exhibitions was conducted by Armour graduates. Fritz Forss, '29, and James Wack, '29, who are employed in the sales department of the Teletype Corp., were in charge of the demonstration of their firm's mechanical typewriter.

Inter-Honorary Dance Attracts Alumni

Fifteen alumni attended the Inter-Honorary Dance in the Dutch Room of the Bismarck Hotel on May 2. Among those present were Boyden Hindman, '29, who is with the Public Service Co. of Northern Illinois, L. F. Bernhard, '29, editor of the Armour Engineer last year, and J. C. MacDonald, '29, of the Multi Electric Mfg. Co.

Kapke Interviews Juniors and Sophomores

Elmer B. Kapke, '28, district manager for the Milwaukee Electric Crane and Hoist Co., was at school a few weeks ago with another representative of the same firm. Junior and sophomore students interested in sales work were interviewed. Kapke is now permanently located in Chicago.

Elmer Geiger, '29, is employed in Greenville, Indiana. He is engaged as assistant manager in a power plant there.

Earl H. Smith, '17, was recently appointed assistant chief engineer in addition to his position as experimental engineer of the Oldsmobile Co. at Lansing, Michigan.

Another one of the recent graduates has entered into the happy bonds of marriage. Charles Lamb, '29, was married last fall to Miss Helen Carlisle, who used to be employed at the Institute as a stenographer. Lamb is working with the Ohio Inspection Bureau at Columbus.

George Kleinhans, '29, and Robert Stemple, '29, were at school the other day. They stopped by on their way down to Champaign, Illinois, where they were going to take the state board examination for architects. Both of them are now employed in architects' offices here in Chicago.

Ralph Phelps, '29, is displaying his fire protection engineering ability with the Michigan Inspection Bureau. He is located in the branch office at Grand Rapids.

The Sanitary District of Chicago now has among its emplyees Edwin Janssen, '27, who graduated as a civil engineer. Janssen was working in the office for a while, but is now out directing a "gang."

PERSONALS

Max H. Marine, '22, has been practicing law for about three years. He has his office in the Conway Building, 111 W. Washington Street.

Leonard Peterson, F. P. E. '16, came from New York to speak at the regular meeting of the F. P. E. Society in Science Hall, Wednesday, April 16.

Mr. Peterson, who is Division Underwriter for the Home Insurance Company, spoke on "Use and Occupancy Insurance."

Paul Steinert, '28, is a member of the research department of the American Can Company. Recently he visited his friends at the Institute.

Fred B. Farrell, '29, has been working on a shovel excavation job. He is with the Division of Management, U. S. Bureau of Public Roads.

Russell E. Johnson, '29, who had previously been with the Nebraska Inspection Bureau at Omaha, is now with the Iowa Insurance Service Bureau at Des Moines.

Kent Parker, Wm. McD. Horn, both of 1928, and John Hommes, '29, are fire protection engineers, putting their knowledge and abilities to the best practical advantage of the Kentucky Inspection Bureau.

J. H. Clouse, '20, was a recent visitor at the Institute. Clouse was head of the physics department at the Sioux Falls, S. D., high school for eight years. At the present time he is an instructor in mechanical engineering at the University of Notre Dame.

Otto S. Peterson, '26, writes that he has left the Kentucky Actuarial Bureau and is now Insurance Engineer for the Phister Insurance Company with offices in the Pierce Building in St. Louis, Missouri.

Recently we received a letter from F. C. Zanzig, '09. He has left the steam turbine department of Allis Chalmers Manufacturing Company where he had been checker of designs for the past five and a half years. He is now Plant Engineer of the Milwaukee Stamping Company in West Allis, outside of Milwaukee.

A brief note from Seymour Goodheart, '29, advises us that he is very much taken up with our capitol city. He is working for the government and wishes his friends to write any news to him at 1840 California St., N. W., Washington, D. C.

Allan H. Joseph, '24, has been transferred from the Chicago office of Link-Belt Company to their office at Dallas, Texas. He is an engineer for the company in that territory and can be reached in Room 1101 Mercantile Bank Building, at 810 Main Street.

Aurora Armour Club Hears Finnegan Talk

The Aurora Armour Club held its spring meeting at the Elks' Club of Aurora, Saturday, April 26. The principal speaker of the evening was Professor J. B. Finnegan, who spoke on the subject of "Engineering Education." There were also short talks by C. I. Carlson, '19, the president of the organization, and graduating members. H. W. Mullins, '30, acted as toastmaster.

The Aurora Armour Club is composed of alumni and undergraduates of Armour Institute residing in or near Aurora, for the purpose of encouraging engineering education.

THE PLEASURE BOAT

Come, hoist the sail, the fast let go!
They're seated side by side;
Wave chases wave in pleasant flow;
The bay is fair and wide.

The ripples lightly tap the boat.
Loose! Give her to the wind!
She shoots ahead; they're all afloat;
The strand is far behind.

The sunlight falling on her sheet,
It glitters like the drift,
Sparkling, in scorn of summer's heat,
High up some mountain rift.

The winds are fresh; she's driving fast
Upon the bending tide;
The crinkling sail, and crinkling mast,
Go with her side by side.

The parting sun sends out a glow
Across the placid bay,
Touching with glory all the show—
A breeze! Up helm! Away!

Careening to the wind, they reach,
With laugh and call, the shore.
They've left their footprints on the beach,
But them I hear no more.

—Richard Henry Dana.

An announcement of marriage of Willys E. Thomas, M. E., '29, to Miss Mary Burnett of Oak Park, on March 22, has been received. Thomas is connected with the McQuay Radiator Company.

L. M. Endres, '25, paid a visit to the Institute on Tuesday, April 15. Mr. Endres is employed by the Nebraska State Highway Commission and lives in Lincoln. He is still an enthusiastic radio fan.

F. M. Kratohvil, 28, made a call at the Institute on Monday, April 14. Mr. Kratohvil is a radio inspector for the federal government and now has his headquarters in Detroit. He nearly burned the tires off his car in driving from Detroit to Chicago in seven and one-half hours.

Dr. Lee DeForest Visits Institute

On Thursday, March 21, the student body and faculty of Armour had the honor of hearing Dr. Lee DeForest, known to everyone as the "Father of Radio."

Dr. DeForest graduated from Yale in 1899 and then came to Chicago to accept a position in the experimental telephone laboratory of the Western Electric Co. Not being satisfied with the time available for carrying out his experiments, he accepted a position at Armour as an instructor in the department of Physics and Electrical Engineering. He received no salary, but in return for his labors, he was to have access to the laboratory and all laboratory equipment for carrying on his work. At the same time he taught two nights a week at Lewis Institute and received a salary of five dollars a week.

With the aid of Professor Freeman, brother of the present head of the Electrical department, Dr. Lee DeForest developed one of the first successful wireless sets in America, and his first message was sent from the Institute and received at the Lakota Hotel. Later, the distance was increased and messages were received with more regularity. The old fashioned coherers were used as detectors and they were so unsatisfactory that DeForest determined to develop something better. After much study and work he developed an electrolytic detector which he called the "anti-coherer." In 1906 he had invented the three-electrode tube consisting of a third electrode, the grid, placed in between the filament and plate of a thermionic tube. It was this invention that has made possible the great strides in radio in the past few years and that has brought the most fame and wealth to its inventor.

After 1921, he devoted his time to the development of the so-called phono-film, a talking picture, involving synchronization of sound and motion by the photographic reproduction of sound waves.

'Bob' Schreiner Dies Suddenly

Robert F. Schreiner, '17, died suddenly a short time back after an operation for appendicitis. He had been employed in the improved risk department of the Home Insurance Company for years. He is survived by his wife and two children.

His death was a shock to his many friends. He had been a loyal and enthusiastic alumnus and was well liked by all who came in contact with him. Many of his classmates and friends extended their sympathy to his widow.

Stanley Charlton, '21, and wife were killed Saturday, March 1, 1930, in an automobile accident at Lake City, South Carolina. Mr. Charlton and his wife were returning to New York from Florida when the fatal accident occurred. Mr. Charlton was manager of the New York office of Balfour & Co., Fraternity Jewelers.

Another of the old-timers was around the school the other day in the person of Clif Burnham, x-'14. He said he was getting along fine and was still able to get in his 18 holes of golf every Saturday

AMERICA

TRAVELS IN HIGH

This is an age of speed, comfort, smooth coordination. The telephone has helped to make it possible.

During the last thirty years the public has increased its use of the telephone 900%. At the same time the Bell System has kept making service faster and more accurate.

To improve and increase facilities, more than 550 million dollars were expended in 1929, and similar work in 1930 calls for an even greater amount.

The telephone is modern for the moderns—up with the times in every phase of life.

Voice communication from shore to ship, telephotography and telephone typewriting are now every day services; and other new developments are at the threshold of commercial use.

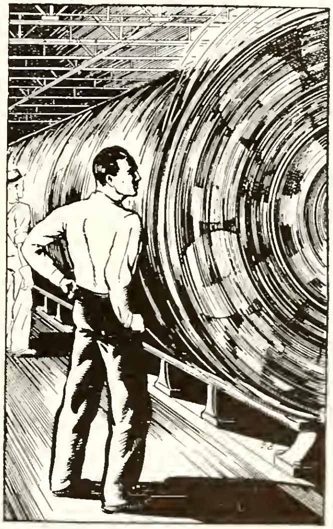
‹ ‹ and to make it possible, WESTERN ELECTRIC also keeps in step

Since this age of speed depends upon adequate telephone facilities, Western Electric too must travel in high.

Fast whirl the wheels of production—turning out in 1929 a million and a half telephones, seventeen thousand miles of cable, a million and three-quarters loading coils—in all more than fifteen thousand carloads of this and other equipment for the Bell System.

Western Electric constantly plans to meet communication needs of one, two and even five years hence. A new factory at Baltimore has recently swung into production — extensive additions to plant are rising swiftly at Chicago and Kearny, New Jersey.

More and more equipment must be made, new kinds of apparatus are called for, improvements are being effected in products and processes. Thus Western Electric plays its part in keeping the telephone "up with the times."



Speeding up the manufacture of telephone cable.

BELL SYSTEM

A nation-wide system of inter-connecting telephones

"OUR PIONEERING WORK HAS JUST BEGUN"

AYE, AYE, SIR!

Captain (to gunner): "See that man on the bridge five miles away?"

Gunner: "Ay, ay, sir."

Captain: "Let him have a twelve-inch in the eye."

Gunner: "Which eye, Sir?"

First Gob: "They say Jones' wife had triplets after reading 'The Three Musketeers'."

Second Gob: "Good heavens, mine was reading the 'Birth of a Nation' when I left."

The absent-minded professor had been killed. He jumped from an airplane and didn't open the parachute, because it wasn't raining.—*Annapolis Log.*

Flapper: "George, if you don't stop I'll scream—I'll call mother! Mother! Mother! . . . Oh, my goodness, George, here she comes. I never dreamed she was home!"

Guide: "On our right we have the palatial home of Mr. Gould."

Old Lady: "John Jay Gould?"

Guide: "No, Arthur Gould. And on the left is the residence of Mr. Vanderbilt."

Old Lady: "Cornelius Vanderbilt?"

Guide: "No, Reginald Vanderbilt. And in front is the First Church of Christ. (Turning to Old Lady) Now's your chance!"—*Annapolis Log.*

GOOD EXAMPLE

Professor: "Can you give me an example of a commercial appliance used in ancient times?"

Student: "Yes, sir, the loose leaf system used in the Garden of Eden."

A pedestrian is a college boy's father.
Judge.

Ardent Youth: "Marry me, dearest, and make me the happiest of men!"

Young Lady: "Have you seen father and mother?"

Youth: "Yes, I have, but I never was a believer in heredity."

"The manager of the department store fired Umson."

"What for?"

"Umson took the sign 'How Would You Like to See Your Girl in This?' off a swell dress—"

"Uh huh—"

"And carelessly hung it onto a bathtub."

Manager: "Do you drink?"

Applicant for Job: "I'll have a small one, thank you."

WAITING

Such fun, this job hunting. You know, being a college man, I never wear a hat. Yesterday I was standing in a bookshop waiting to be hired, when a lady came in, picked up a book, and handed me two dollars. Today, I'm going to loiter in the piano store."—*Centaur.*

Be original. Don't wear suspenders or a belt. Eventually your originality will be noticed. Oh, my, yes.

The Zero Hour

THE LOCATION

She: "Did I ever show you the place where I hurt my hip?"

He: "N-no."

She: "All right, we'll drive over there."

Irene Thomas, pretty typist,
  Really made a hit
With her new boss, Dave A. Mayer,
  But she had to quit
When he noticed on each letter,
  She had signed "Dam it."

CAESAR IN A SPEAKEASY

Veni, vidi, whoopee!!
—Michigan Gargoyle.

A SHREWD POLICYHOLDER

Anxious Wife: "Abie, have you done anything about that Black Hand letter?"

Abie: "Oh, ain't I, though. I turned it over to my insurance company. They got $20,000 tied up in me; let them worry."

"Is your wife entertaining this year?"
"Not very!"

BE NATURAL

Photographer (taking picture of father and college-boy son): "Perhaps it would make a better picture my boy, if you were to stand with your hand on your father's shoulder."

Father: "The picture would be more natural if he stood with his hand in my pocket."

Ethel: "Yes, but I won his consent. I told him that he need not lose me. We could live with him, and so he would not only have me, but a son-in-law to boot."

Jack: "H'm! I don't like the expression 'to boot'."

"Do you love me?"
"Indeed I do."
"How much?"
"A whole bushel."
"Well, a bushel is four pecks, and I'll take 'em right now."

She: "A survey shows that women live longer than men, though men are more healthy."

He: "And here's another fact: Men live longer than draught horses, though the horses are healthier. It depends on who is doing the driving."

"Conductor! Help me off the train."

"Sure."

"You see, I'm stout, and I have to get off the train backwards; the porter thinks I'm getting on and gives me a shove on again. I'm five stations past my destination now."

"Dearest," said the newly-wed hubby, "there must be something wrong with this pie."

"It is blueberry pie, Precious," she replied. "It ought to be all right, but perhaps I put a little too much bluing in it."

Expectant Waiter: "And how did you find your steak, sir?"

Guest: "Oh, I just happened to lift up that potato, and there it was."

"What do you mean by saying that he is a triple-threat man?"

"Well, he's a good necker, he can play the saxophone and he has a Chrysler."

College Grad's Mother: "Here's a letter from our boy at last."

Farmer Corntassle: "Has he got a job yet?"

Mother: "Yes, he's washing dishes in a restaurant."

Farmer Corntassle: "That's good. He told us he was going to clean up a million when he left the farm."

HOW HERCULES EXPLOSIVES ADVANCE CIVILIZATION

EXPLOSIVES
MAKE POSSIBLE THE
NATION'S HIGHWAYS

REMEMBER when you drive over America's roads—a network of highways that knits the country from the Atlantic to the Pacific and from Canada to the Gulf of Mexico—you are indirectly utilizing another of explosives' many contributions to our civilization.

For dynamite makes the modern highway possible. Stone, cement, asphalt, and other road-building materials—all are first wrested from the earth by explosives. Explosives also blast trails over mountains, drain encroaching waters, aid in the construction of bridge abutments, and in other ways afford easier access to cities and towns.

Not only in road building, but in many industries—on land and sea and underground—explosives are helping us enjoy a richer, fuller civilization.

In these achievements, Hercules explosives have played, and will continue to play, an important part. You will find it well worth while to know more about this engineering tool. Write for a copy of *The Explosives Engineer.*

HERCULES
POWDER COMPANY
(INCORPORATED)
941 KING STREET
WILMINGTON, DELAWARE

CHEMICAL AGENTS AND THEIR APPLICATION

(*Continued from page* 135)

is an acute infectious disease transmitted from an infected person by the bite of the body louse (pediculus vestimenti). Every person arriving in quarantine infected with lice is detained until deloused, and the baggage of such passengers fumigated. The Chemical Warfare Service developed a special gas mask canister for use in connection with fumigation. Hydrocyanic acid and cyanogen chloride being the only toxic gases for which this canister is used made it possible to have a high capacity for absorbing them. An investigation was made for absorbents of these two gases, resulting in a combination of two absorbents found to be particularly effective. The mixture is proportioned so that when the canister is exhausted, cyanogen chloride, rather than hydrocyanic acid, penetrates. The cyanogen chloride, being very easily detected by its odor, serves as a warning agent of the exhaustion. The amount of cyanogen chloride which penetrates at exhaustion is extremely small for some time, enabling the wearer in an emergency to finish his work with little discomfort, although he should ordinarily leave the contaminated atmosphere at once. An exhausted canister is easily replaced by a new one. In addition to the above, canisters that will protect against ammonic fumes, also those which will protect against carbon monoxide, have also been developed by the Chemical Warfare Service.

Carbon monoxide was not one of the so-called war gases, but is a very toxic gas and is one of the products resulting from the burning or detonation of military explosives. Many deaths resulted from carbon monoxide produced in this way. It was reported that in the battle of Jutland there were many casualties from carbon monoxide poisoning on both sides. On one vessel alone several hundred men were fatally affected by carbon monoxide produced from burning cordite, a propellant explosive.

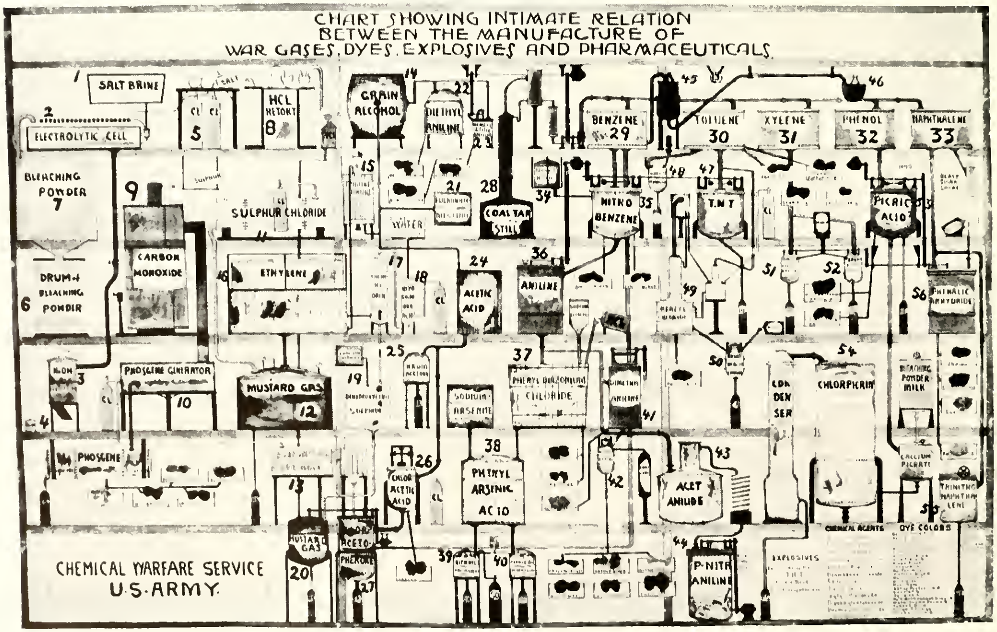
To provide protection against carbon monoxide was not an easy matter, since it is not absorbed or neutralized by the ordinary gas mask canister absorbents, charcoal and soda lime, nor does it react readily with other chemicals at normal temperatures.

It was ultimately discovered, however, that a special prepared granular mixture of the oxides of copper and manganese to which the oxides of silver and cobalt were sometimes added, would oxidize carbon monoxide when mixed with the oxygen of the air to carbon dioxide, a relatively harmless gas. This mixture of metallic oxides is called "Hopcalite" in honor of the two universities "Johns Hopkins" and "California" at which the basic principles underlying such oxidation catalysts were evolved.

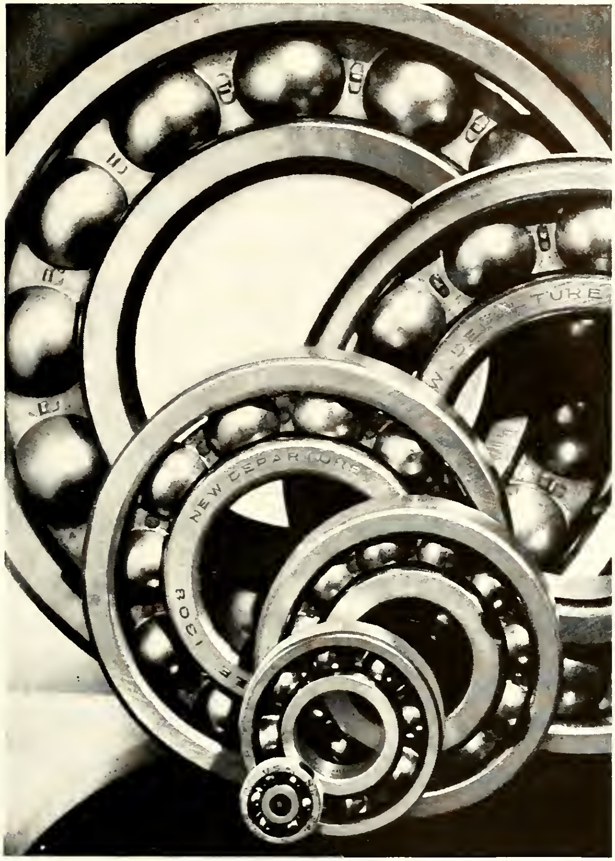
Hopcalite will oxidize carbon monoxide indefinitely, if it is kept dry and not contaminated, but moisture causes rapid deterioration. For this reason, when Hopcalite is employed in gas mask canisters, it must be protected by some absorbent which will eliminate moisture from incoming air. Calcium chloride is such an absorbent. The useful life of Hopcalite, therefore, depends on the efficiency and capacity of the moisture absorbent employed, and the life of the absorbent, in turn, depends on the percentage of moisture in the atmosphere, the rapidity with which air is drawn through the canister and the amount of absorbent filling employed.

The first gas mask canisters containing Hopcalite which were manufactured were those produced by the Chemical Warfare Service for the Navy Department during the World War. After the war, industrial gas mask canisters containing Hopcalite were developed for the protection of miners, firemen, and other operators who may encounter toxic concentrations of carbon monoxide.

Some of the industrial gas masks, such as the self-rescuers, provide protection only against carbon monoxide, while others, such as the uni-



NEW DEPARTURE BALL BEARINGS



**NEW DEPARTURE
MANUFACTURING
COMPANY** BRISTOL CONN.

A SPECIAL STEEL THAT ENDURES the merciless punishment of speed, stress and shock without perceptible wear—balls and raceways that defy imagination with their matchless perfection—these suggest the superlative quality of New Departure Ball Bearings. And they explain, too, why engineers select New Departures for long, hard service wherever the wear and waste of friction are to be eliminated to the last possible degree. For pure, rolling motion is frictionless and

NOTHING ROLLS LIKE A BALL

versal and the firemen's gas mask, provide protection against many toxic gases and smokes which may be encountered in industry or in fighting fires.

All of these gas masks have certain limitations and those which provide protection against the toxic gases encountered in one industry may provide little or no protection against the toxic gases encountered in another industry. One should always be certain that the gas mask employed will provide protection against the gas to be encountered. It should also be remembered that no gas mask canister will stand up for any appreciable length of time against extremely high concentrations of toxic gas such as may be encountered when released from a cylinder. NO CANISTER TYPE OF GAS MASK IS SUITABLE FOR USE IN ATMOSPHERES CONTAINING INSUFFICIENT OXYGEN TO SUPPORT LIFE AND THEY CANNOT BE USED INDEFINITELY EVEN IN ATMOSPHERES CONTAINING RELATIVELY LOW CONCENTRATIONS OF TOXIC GAS.

White phosphorus, titanium tetrachloride, hexachlorethane, and crude oil are non-toxic smoke producing materials used to screen men and objects from observation and are employed by placing them either on or in front of the observer. White phosphorus and crude oil are well known commercially in the phosphorus match and paint industry.

Protection.—Chemical agents are easily protected against when their chemical and physical properties are understood.

The army gas mask furnishes adequate lung protection against all chemical agents as found in field concentrations. If the wearer has learned how to put his mask on and has sense enough not to remove it while in the presence of these agents, he has little to worry about. It must be borne in mind, however, that the canister of a gas mask is designed and manufactured to protect the wearer against certain chemical agents and not against such gases as are produced by the slow burning of x-ray and motion picture films. Following the Cleveland Clinic Hospital disaster, May 15, 1929, which resulted in 125 deaths caused largely from nitrous fumes or poisonous oxides of nitrogen given off by burning or decomposing nitrocellulose products, the Chemical Warfare Service made an investigation and conducted experiments leading to the prevention of a recurrence. As a result of much research some very essential recommendations were made and are published for the public welfare.

With reference to the lasting effects of chemical agents on the lungs, the following is quoted from "War Gases and Tuberculosis," reprinted from the Archives of Internal Medicine, June, 1927, Vol. 39, paragraphs 833-864. In 1922, Meade summarized the histories of over three thousand persons examined by War Risk Insurance Bureau in Kansas City. As a result of his work he made the following statement: "I now believe that we can say to the public upon the best authority (which is based upon universal observation) that a man is no more liable to tuberculosis as the result of gassing than is a man who has never been gassed."

OPPORTUNITY

Master of human destinies am I.
Fame, love, and fortune on my footsteps wait,
Cities and fields I walk; I penetrate
Deserts and seas remote, and, passing by
Hovel and mart, and palace, soon or late
I knock unbidden, once at every gate!
If sleeping, wake—if feasting, rise before
I turn away. It is the hour of fate,
And they who follow me reach every state
Mortals desire, and conquer every foe
Save death; but those who doubt or hesitate,
Condemned to failure, penury and woe,
Seek me in vain and uselessly implore—
I answer not, and return no more.

John J. Ingalls.

Evaluation. — Chemical agents have certain values, for if it is true that there is nothing new under the sun, then either this world has progressed through millions of years in spite of the presence of all things, or all things have values.

As stated above, most of the coal tar dyes are so closely related with chemical agents that it would be hard to say whether the intermediate used would finally get into a dye or a chemical agent. Chlorine, caustic soda, and hydrochloric acid being three vital intermediates in the manufacture of medicinals as well as many peace and war time chemical products, their value should not be underestimated.

During the World War 65,038,810 men were mobilized by the countries participating. Of these 1,009,038 were reported as being gas casualties.

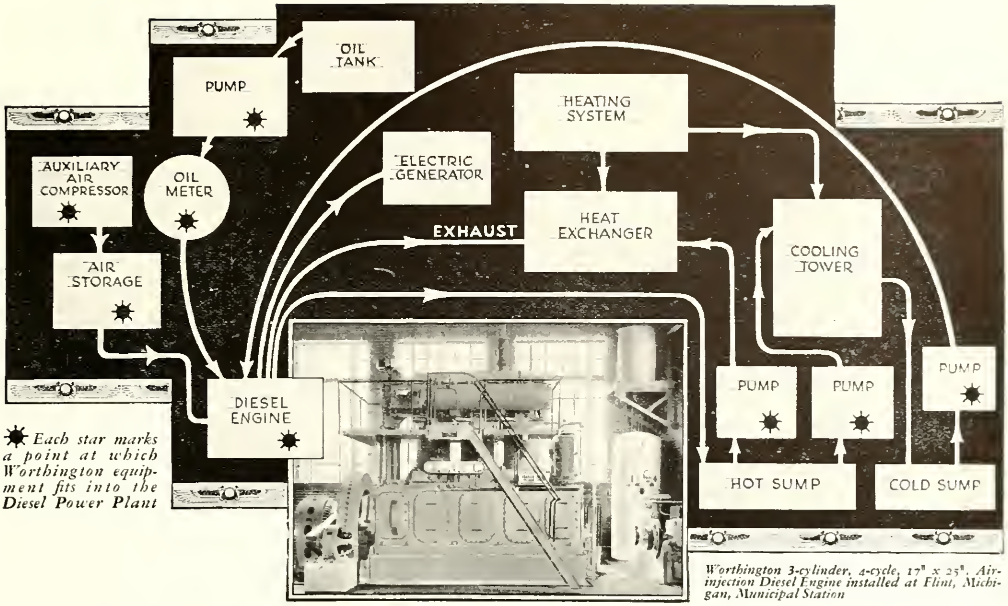
The American Expeditionary Forces reported 2,039,329 to have arrived in France. The report of the Surgeon General shows that out of 258,338 casualties about one-third resulted from chemical agents with less than two per cent deaths; also that by careful measures 75% of the mustard casualties were physically fit within two months. From these figures one can draw his own conclusions as to the war time value of chemical agents.

HIGH FREQUENCY RADIO BEAM TRANSMISSION

(Continued from page 139)

mitter aerial A, number of reflecting wires on either side of B are added. The entire system is supported by a framework such that in outline the reflecting surface is a parabola with A at the focus. Figure 2 shows the plan view. All the energy radiated by A within the angle P A Q will be reflected in the direction parallel to the line A B. The horizontal concentration of the beam is proportional to the distance P Q, the width of aperture. Figure 1 shows such a system erected.

Parabolic reflecting antennae have been constructed with good results. However, at the lower frequencies, the installation becomes rather large and difficult to construct mechanically. For this reason it is being superseded by the Franklin System, though the reflector is more efficient electrically. In the present Marconi stations, the projection of the wave is not accomplished by the use of a skeleton parabolic mirror as described above, but is attained by means of a system of vertical wires at equal distances and in one plane with a series of reflector wires behind it in a parallel plane at a distance of one-quarter wavelength. The plane of the aerial wires is placed normally to a great circle of the earth passing through the transmitting and receiving stations. These aerial wires are supplied with high frequency currents of exactly the same strength and exactly in phase with each other. A sketch of the Franklin beam antenna is shown. The foremost grid is the antenna and directly behind it is the reflector. Each wire in both nets is supplied



Each star marks a point at which Worthington equipment fits into the Diesel Power Plant

Worthington 3-cylinder, 4-cycle, 17" x 25", Air-injection Diesel Engine installed at Flint, Michigan, Municipal Station

Flint wanted dependable lighting *. . . and got it*

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Literature on request

WHEN Mr. Consumer quits for the day, he wants to relax. If he's a radio fan, he wants freedom from line voltage fluctuation; if he reads, he wants steady light; if movies are his weakness, he wants them flickerless.

In Flint, Michigan . . . city of automobile manufacture . . . they have to relax. But they are wide awake on the subject of lighting.

They wanted dependable low-cost power for their lighting system, and they got it . . . with a modern Worthington 3-cylinder 4-cycle Diesel Engine direct-connected to an a. c. generator.

Now in its third year of service, this unit is rendering steady, dependable service . . . representative of the performance promised for and delivered by *every* Worthington Diesel Engine. *Write for information on this type of equipment.*

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with an equal amount of energy in phase.

A single vertical wire transmits power in all directions. Let this wire be extended into a row of aerials, spacing the components sufficiently close to maintain uniform distribution of field. The original supply of energy is now divided equally among the aerials. The direction of field intensity is now perpendicular to the axis of the row, and further extension of the row concentrates still more the radiation in the perpendicular direction. Now, if a second row of similarly tuned antennae is situated one quarter wavelength behind the row, the former will oscillate in a similar manner, radiating mainly in the same direction. The two radiations in the one direction will cancel while those in the other direction will add. Thus, the combination of a transmitter system and reflector system results in the production of a single beam of radiant energy in a direction at right angles to the line of aerial wires and on the side opposite to that on which the reflector wires are situated

In 1926, H. Chireix succeeded in achieving the transmission of a wireless beam in a somewhat different manner. It is now employed by the Societe Francaise Radio-Electrique in its installations in France and her colonies. The marked advantage over the Franklin system is that the number of feeding points is reduced to two, resulting in a more simple construction.

Consider a wire developed in zigzag with right angles or elbows supplied at the center with high frequency energy. If the length of each strand is one-half a wavelength, the aerials sloping one way form the first row of half wave aerials in phase and the aerials at right angles constitute a second row of half wave aerials also in phase. The field strength produced by each row leads to a polar diagram of two beams in opposite directions. If the system is doubled, the two power supply wires are the seat of equal and opposite potentials and therefore do not radiate energy. Furthermore, the effects of the second system will be added to those of the first. Maximum energy is radiated in a direction parallel to the ground. If a reflector of identical construction is placed one-quarter of a wavelength in the rear of the aerial, the back field will be absorbed entirely, while the field in a forward direction is doubled for a given current in the aerial. The success of this system is assured by the results of tests wherein practically all the radiant energy was concentrated in a beam ten degrees wide on the horizontal plane.

The introduction of the beam system of high frequency propagation is revolutionizing radio communication. The general public is not aware of this fact owing to their limited interest, but by those who are making science, the radio beam is considered a highly significant advance.

England was the first nation to take advantage of its possibilities. For many years its dominions had expressed the desire for a rapid and efficient means of communication with the mother country. Radio, obviously the only possibility, had not yet proved itself capable of even remotely satisfying the rigorous conditions to be met. Thus, when early in 1924 the British Marconi Company requested the English government's permission to establish such a system, we may be sure that grave doubts were experienced by the more conservative members of the Postoffice Department. Were it not for the reputation of the company, permission would probably have been refused. At any rate, a contract was drawn up with stringent specifications which to the average radio engineer represented sheer impossibilities.

I first lived in a little house and lived there very well;
I thought the world was small and round and made of pale blue shell.
I next lived in a little nest nor needed any other;
I thought the world was made of straw and brooded to my mother.
One day I flew beyond the nest to see what I could find;
I said the world is made of leaves, I have been very blind.
At length I flew beyond the tree quite fit for grown-up labors;
I don't know how the world is made, and neither do my neighbors.

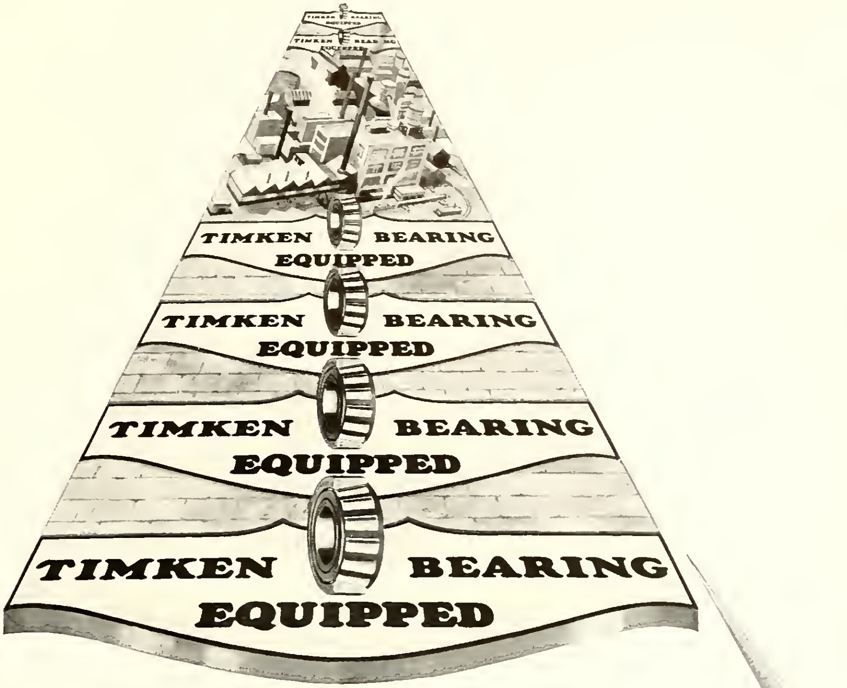
—*Anonymous.*

Great Britain was to be assured reliable communication with South Africa, Canada, India, and Australia. The power of none of the stations was to exceed twenty kilowatts and the radiation was to be confined to a sector 30 wide, the energy emitted beyond this angle not to exceed five percent of that on the axis. The stations were to be capable of handling traffic consistently at a speed of one hundred words per minute. For comparison, commercial radio communication in 1924 was carried on by long wave stations having an output of several hundred kilowatts, useful only for a daily average of eighteen hours with an average speed of twenty words per minute. The range of such a station was five thousand miles under satisfactory conditions. The contract called for stations with about three percent of that power, useful for very nearly twenty-four hours, with a minimum speed of one hundred words per minute, capable of working 10,000 miles! Could it be done? Marconi was certain that it could. He had the beam "up his sleeve."

Before the end of the year, the first station was erected in England for work with South Africa. With a Postoffice committee in attendance, it was put through its evolutions and the station met every one of the contract specifications with a liberal safety margin. The results were unprecedented in the history of radio communication; a new era had been reached. The plan, not yet completed, includes stations at Bodmin and Bridgewater in England for communication with Montreal, Melbourne, Bombay, Cape Town, and Rio de Janeiro.

The Societė Francaise Radio-Electrique last year erected stations for communication with South America and Indo-China. Twenty-four hour contact has been enjoyed with Buenos Aires while, with a power of ten kilowatts, public telephone communication is held between France and Saigon (Indo-China). The wavelengths employed are below twenty meters.

The most obvious advantage of the beam system is that less power is necessary to carry on communication, resulting in substantial economy in capital and working expenses. A low-power beam has many times the effectiveness of a high power station using an ordinary antenna. Let a circle represent the field-strength curve of a non-directional antenna with a radial field and consider a beam, the energy of which is concentrated in 18°. The power required to produce unit field strength at any distance will be 18/360 that required if the energy is radiated uniformly throughout the 360°, the case with a non-directional aerial. The beam requires 1/20 of the power required by the other antenna. If a reflector be set up at the reception point B, the over-all efficiency will be the square of the efficiency obtained with only



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one reflector at the point A. The power ratio in the case considered would be $(1/20)^2$ or 1/400. The results obtained by experiment are even more satisfactory because the area of the beam polar curve is less than that of the sector assumed. By measurement, the power required to produce equal signals using similar aerials at both ends has been found to be in the ratio of 1.56 to 10,000.

A second advantage is that the speed of transmission and reception is markedly increased by use of the beam system. The possible speed of working such a station has been found to be 200 times greater than that attainable with a low frequency non-directional station. This improvement is due to the shorter time required to charge an antenna when high frequencies are used and to the increase of signal-static ratio resulting from more powerful signals and less audible noise-level at the receiver.

A third advantage is the great reduction of mutual interference and a possibility of secrecy in communication. It is clear that a number of beam stations, each with its radiant energy confined to a small area, may work on the same frequency with perfect ease. The following prophecy has been made by C. S. Franklin: "Today, the possible gamut of wavelengths is becoming very fully occupied; the time will soon come when the only way of increasing the number of possible services will be to employ systems having good directional characteristics." This statement was made eight years ago. That time has arrived. As to secrecy, the signals received outside of a beam are rarely strong enough to work the necessary high-speed recording instruments.

Another advantage arising from the use of the beam system is that atmospherics are minimized. A receiving station with a reflector antenna collects only 1/20 of the static disturbances which would be heard by the same receiver using a non-directional antenna. Marconi has this to say: "I feel confident that our old enemy, static interference, no longer exists as a serious hindrance to the working of high speed radio as carried out by the beam system."

Again we hear the prophetic words of this great authority: "A good directional system is the note of the future for point-to-point radio communication over long distances throughout the world."

THE NEW SCIENCE

(Continued from page 137)

ties of an element. Moseley's work showed that the controlling force is the nuclear charge.

While Rutherford's conception of the atom was very satisfactory from the standpoint discussed above, it offered no satisfactory explanation of energy content and radiation. If energy was continually emitted by the electrons due to their revolving in orbits about the nucleus, it would soon become entirely dissipated, contradicting ordinary observations. To overcome this difficulty, Bohr introduced the very useful idea of stationary states or energy levels in the atom in which the electrons may revolve without absorbing or emitting energy. The energy levels are concentric orbits and if the atom is to emit energy it must pass from a larger to a smaller orbit, always disposing of the energy in definite parcels or quanta of electromagnetic light. When in a stationary state, the attraction between the nucleus and the electron is balanced by the centrifugal force of the electron. If the electron takes a smaller orbit, part of the difference in energy between the two states is used to increase its kinetic energy and counteract the stronger nuclear attraction. Unfortunately, the frequency of the emitted radiation is not a function of the speed of revolution of the electron but is dependent upon more complicated phenomena. Figure 5 represents a hydrogen atom drawn with a circular orbit instead of an elliptical one, for simplicity. The difference in energy content or the energy which may be emitted between two levels, as indicated by figures, may be expressed as the difference in energy required to bring an electron from infinity to each level. Greater potential energy is possessed by the electron when in the outer levels, and in the event that it drops to a low or normal level, it may again absorb energy and assume a higher position. The advantage of the Bohr assumption over the Rutherford idea is apparent when considering such examples of stable potential energy as in coal, oil, and other combustible matter.

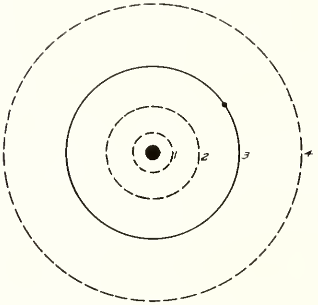

Fig. 5. The Bohr model of the hydrogen atom, showing the electron traversing one of the many possible orbits, four of which have been indicated. Each orbit represents a stationary energy level.

A very significant example of the effect of the atom where heat energy is concerned is the relation between the specific heats of the elements. Multiplying the specific heat by the atomic weight will give the heat required to change the temperature of a gram atomic weight of an element one degree. The product is found to be a constant for all elements stable and solid at ordinary temperatures. Since gram atomic weights of all elements contain the same number of atoms, it is to be concluded that the same amount of energy is required to raise the temperature of any atom one degree.

It is in the foregoing fundamental theories that atomic physics has fixed its roots, and it hopes that in the near future it shall have received sufficient nutrition from active minds to present discoveries of unprecedented importance and advance the knowledge of man a very large notch toward his goal of perfection.

* * *

The Ethical Standards of the engineering profession should be those of a fraternity. The engineer should recognize that he is endowed by the profession and the state in the specialized knowledge for peculiar judicial and responsible public service involving the life, safety, comfort and convenience of his own and coming generations, and that in response to these he should so conduct himself as to be appreciative of his indebtedness to his profession for his opportunity and make return by every effort, by a life of special usefulness devoid of unseemly greed, and filled, if possible, with a multitude of those small courtesies, the practice of which encourages the spirit of forbearance and is helpfully conducive to the fine art of living well together.

From the Code of Ethics of the
Western Society of Engineers.

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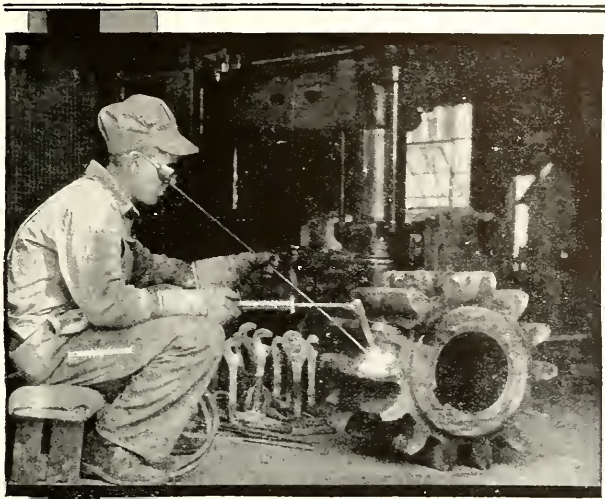

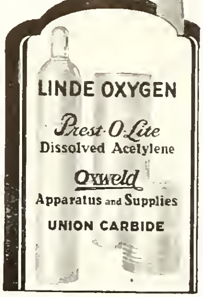

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ANEMOMETER MEASUREMENTS

(*Continued from page* 133)

The tests were not all conducted with the straight duct shown in the illustration. For part of the work elbows and branched ducts having different sized outlets were used so as to reproduce as nearly as possible the various conditions encountered in practice. In some cases the velocity was practically uniform across the face of the grille, while in other cases there was as much as 590% variation in velocity at different points across the face. These factors had no apparent effect upon the results obtained. More recently a new grille having an ornamental design, and another of cast iron approximately one inch in thickness have been tried. Also runs have been made with a different type of anemometer than had previously been used. In all cases the results obtained have agreed very closely with those already discussed. It appears from this that the formula may be regarded as a general one reasonably accurate under practically all conditions.

The new formula has already been officially adopted by the Chicago Department of Ventilation and the Illinois Chapter of the A. S. of H. and V. E. and is unofficially being used in many parts of the country.

Table 2—Summary of Results

Average Indicated Velocity f. p. m.	c. f. m. = $\frac{CV(A+a)}{2}$	
	Supply Grilles C	Exhaust Grilles C
150	0.952	0.993
200	0.957	1.005
300	0.967	1.028
400	0.977	1.049
500	0.985	1.067
600	0.992	1.078
700	0.998	1.084
800	1.000	
Factor for average use	low vel. 0.97 high vel. 1.00	1.02

Note.
A=gross area of grille—square feet.
a=net free area of grille—square feet.

Each table of coefficients approaches a constant value as the velocity is increased so that it is believed that the highest value shown in each case can be used for all higher velocities with very slight error.

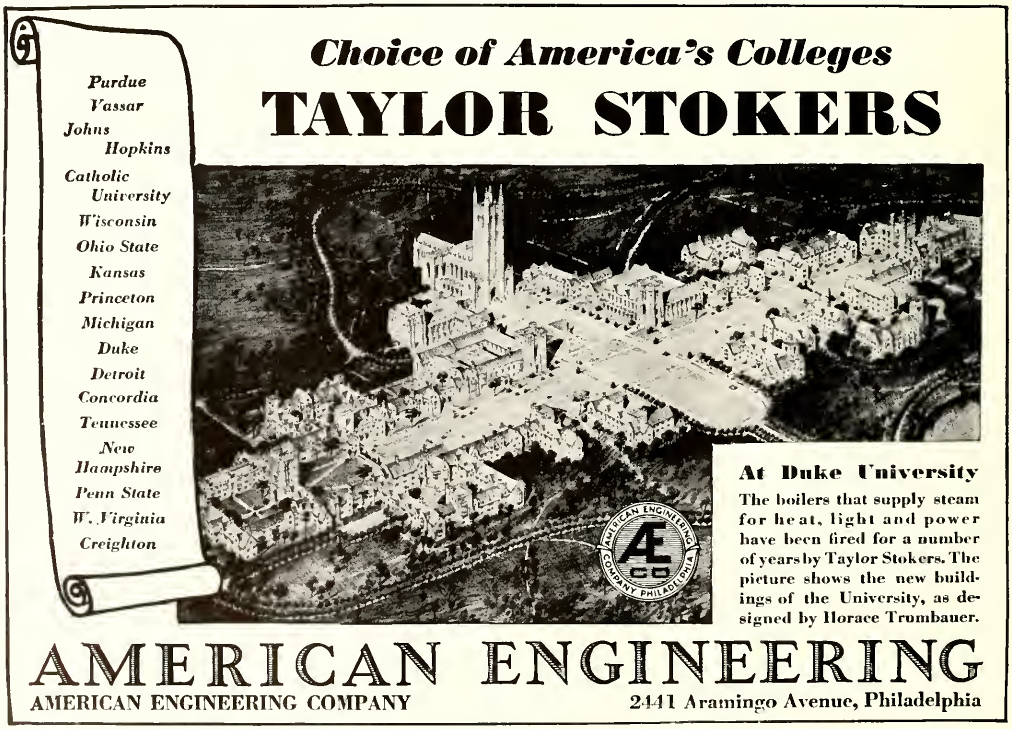
Upon the completion of the research work, which is now being carried on through a cooperative agreement between the Institute, the A. S. of H. and V. E., and the Ventilating Contractors Employer Association of Chicago, it is expected that the findings will be officially accepted by the former society.

A CENTURY OF PROGRESS

(*Continued from page* 131)

of $1,000 and $500. The corporation has assigned to a trustee forty per cent of its gate receipts, to secure payment of the principal and interest on the notes.

The financial end of "A Century of Progress" has thus been solved and there is nothing now to stop the growth and finally the consummation of the idea in 1933. The great benefits to be derived by the entire world from the event can not be overestimated. By the concentration of all the Earth's most noteworthy projects and advancements in one place, humanity may easily grasp the significance of the century's achievements. The significant exhibits, the artistic creations, the athletic contests, and the stupendous scale of the whole affair will give the people of the world a vastly wider knowledge of the enterprise and development of the human race.



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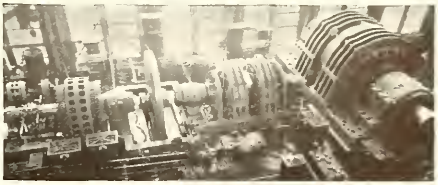

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THE JET-WAVE RECTIFIER

(Continued from page 140)

hydrogen and atmospheric air is 1 to 10.

The jet-wave rectifier has been developed in the municipal power station of Copenhagen, the H. C. Oersted Works. The rectifier used had a capacity of 200 KW at 550 volts. After completion of the development, two complete plants were tested under ordinary working conditions. They were kept under observation for nine months and operated to the satisfaction of all concerned. Especially one of these which had been placed on traction duty demonstrated the ability of the rectifier to withstand, without injury, prolonged short circuits, which would have been disastrous to rotating machinery.

Obviously, jet-wave rectifiers of any size may be produced on the basis of the theoretical and experimental knowledge on hand. While the rectifier is very efficient down to voltages of 55 volts, it is hoped that the efficiencies will be increased as the voltage is raised. Also, the amount of mercury, which is at the present time about half a kilogram per kilowatt, will be reduced. While it is impossible to give figures on the cost of production at the present stage, it seems safe to say that, in this respect, the new rectifier will easily compete with the other available means of alternating current rectification.

In connection with the question of high voltage production, it is interesting to note that the jet-wave rectifier is capable of transforming direct current into alternating as well as vice versa. This, as will be seen, opens up the possibility of producing a direct current transformer by means of which high direct current voltage suitable for transmission purposes may be stepped down for motor operation and illumination.

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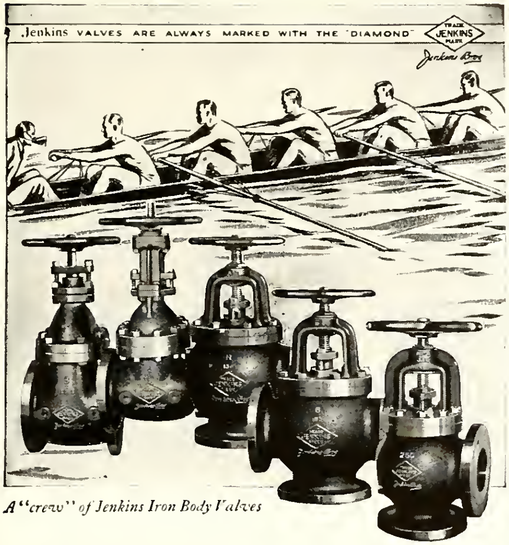
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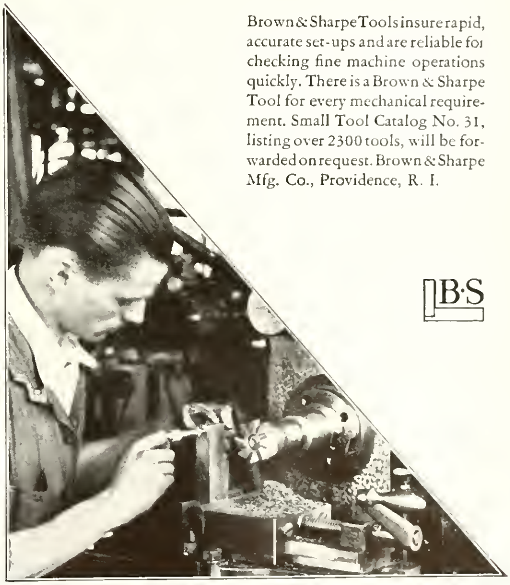

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ENGINEERING NEWS

(*Continued from page 141*)

screwed point is to be permanent. In assembling screwed joints, which must be readily taken apart, there are several measures which may be taken to lessen or avoid freezing of the threaded surfaces.

Where a certain amount of play is not objectionable, a loose fit between the threaded areas is often sufficient. For tighter fits, where considerable pressure occurs, the friction surfaces are often coated with an anti-seize compound in the form of a paste. When the threaded joint is to be periodically taken apart in a shop, this paste may be readily applied at each re-assembly.

A more permanent protection is afforded, however, by an electroplating of zinc on one of the threaded surfaces. This treatment minimizes or entirely eliminates seizing. It has the added advantage that each separation and rejoining of the threaded parts involves no renewal of coating.

Fuseless Fuse Box

The electrical research engineer has recently devised a fuseless fuse box for offices, homes, and all places where electric current finds everyday application.

Fuses are replaced by small circuit breakers, similar in principle to the arc-quenchers employed in the now famous Deion circuit-breaker. The new breaker is automatic and is operated by a bi-metallic latch which bends when heated by an overload current, thus releasing the breaker. The contact bar, on opening, passes through arc quenchers—a series of metallic plates—slotted to permit free passage of the moving contact. The arc quencher plates are insulated from each other and from the current carrying parts. The arc, which is caused by severing the circuit, is stretched as the contacts open, forced into the quencher plates by a magnetic field, and is cooled and extinguished by the thermal capacity of the plates.

Instead of replacing a fuse, as is usually required when the circuit is broken, the only operation necessary on a fuseless panelboard is to push the operating handle which is similar to an ordinary lighting switch. If the excessive current still exists, the breakers will open. If the condition has been removed, the breakers will remain closed.

Ships of The Future

Recently an all-welded barge was launched off the Connecticut coast. Its success when it was completed, introduced the ship of the future.

In order to take advantage of all the inherent possibilities of welded construction as compared with those of the conventional riveted design, this particular barge has been developed so as to combine strong and rugged construction of the utmost simplicity with a carrying capacity at least 25 per cent greater than a similar sized barge of the riveted design. No sacrifice of strength or durability was made in the construction; in fact, a plate thickness was used at all times equal to that of the riveted barge where the questionable joint efficiencies made a heavy plate necessary.

NOT IN VAIN

If I can stop one heart from breaking,
I shall not live in vain;
If I can ease one life the aching,
Or cool one pain,
Or help one fainting robin
Unto his nest again,
I shall not live in vain.

—*Emily Dickinson.*

Low maintenance charges are assured as the welded design does not require the constant attention so necessary due to the hazard of loose rivets and leaky seams.

In developing this welded design, the conventional types of barges and tow-boats have been discarded in favor of a modern design so arranged as to permit assembling of the various parts as separate units, thereby requiring a minimum amount of equipment. Of the material used in the construction, 95 per cent is fabricated at the steel mill and when received at the ship-yard is ready to be assembled and welded in individual units of suitable weight and size. This is done to facilitate handling during assembly at the shipways.

The design makes use of all the advantages feasible in welded construction, eliminating all holes in the material and producing a finished product of striking simplicity. This permits the standardization of all parts, thereby such a design is readily adaptable to mass production.

The barge is all one piece; therefore, there is no chance of air and moisture seeping in at the joints, thereby causing corrosion.

Fire Hazards In Airports

Great advancement in the field of aviation and air transportion has made commercial aircraft come into the limelight as an important public carrier. With the great number of planes in use and with the great number of cities having municipal airports, the necessity of building hangars to house the planes at the airports becomes apparent. In the hangars the planes are repaired and painted, as well as stored, and wherever there is repair work or painting done there is a fire hazard. Fire hazard is greater in airplane repair work than in other industries because of the greater amount of easily ignitible material in the planes. The problem is a new one and there is little or no precedent to guide the engineer in protection against this hazard. However, numerous disasters in hangars, previous to this time, have proved the importance of fire prevention and the need for first aid fire fighting apparatus at airports.

Sprinkler systems and an adequate water supply do not solve the whole problem, by any means. There is quite likely to be burning liquid, such as gasoline, oil, or paint. In some cases the application of water may prove detrimental, because the burning liquid, being lighter than the water, will spread and burn more furiously. Therefore, it is best that there be a supply of first aid extinguishers, either of the carbon tetrachloride or the foam type, available, or, in lieu of better protection, sand, dirt, salt, or any smothering material that is effective in extinguishing an incipient fire.

The problem is too great to be outlined in a few words, but it can well be said that even excellent first aid protection, at best, will only extinguish a fire which is already started and the most important problem is that of prevention. Progress is being made in analyzing the hazards in airports and methods of preventing fires. A number of good rules have been formulated for the keepers and workmen at the airports to follow. As a result of the work done on prevention and protection against fire, the ratio of fire losses to the total aggregate value in airports has been materially reduced since commercial aircraft started, but there is much yet to be learned and corrected and it is one of the important problems for the fire protection engineer to solve in the future.

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GLUE

....In Industry

THE manufacture of glue is an industry as old as the ages. The pages of history disclose, three thousand years ago, the cabinet makers of ancient Egypt laboriously putting together the various parts of their handicraft with a crude form of glue, made under most primitive methods.

3000 years ago . . . . Meanwhile the processes of evolution have transformed ancient Egypt into the modern world: research and science has made commonplace to us today that which would have beeen miraculous in ancient or medieval times: production and marketing methods have advanced to a basis of scientific control:—but glue and glue-making were not a part of this transition.

Thru the ages, glue remained glue, with little regard for the raw material from which it came and the quality of the finished product.

Then a consciousness was awakened to the difference between glues made from the hides of animals and glues made from their bones. Then, gradually, users began to make certain crude tests of various elementary qualities, but these tests relied primarily on the physical senses, and were usually unreliable.

Only a few years ago, comparatively, was glue finally lifted out of crude speculation as to quality and elevated to an exact scientific method of grade measurement. The laboratories of Armour and Company, in cooperation with one other laboratory, were the pioneers who developed the new methods that have since been recognized the world over . . . . and indeed have recently been accepted as standard by the United States Government.

Armour and Company has also pioneered in adapting the form of glue more specifically to the user's needs. For generations, glue was delivered to the user in a flake form. Then came ground glue—only comparatively recently, however. This speeded up his production and was, in many cases, much more practical for his own purpose. Within the last decade, a new process has been invented. It gives the manufacturer glue in the form of a small pearl, combining all of the advantages of both flake and ground glue in a product that permits a further speeding up of production and at the same time guarantees a cleaner and purer product.

Armour and Company were the first to introduce Pearl Glue on a wide scale in this Country and at the present time is the only manufacturer from whom an appreciable supply of this glue is available.

Likewise in marketing practice Armour and Company have left the beaten paths to lead with new ideas.

A staff of trained chemists is maintained for the purpose of contributing the latest thought on good and economical glue practice. Scores of special problems weekly find their way from the manufacturing field to the Armour Laboratories, and painstaking reports are returned giving constructive help.

Out in the field, in addition, Armour and Company maintains chemical engineers who go wherever they are needed, on request, to analyze plant equipment, gluing procedure, and adaptation of grade of glue. Their sole purpose is to give assistance in improvement of finished quality or reduction of manufacturing cost.

So to the industrial engineer and to the student who seeks to bring the wisdom and logic of science to the performance of the task in hand, we say:

If it involves the use of glue, let our technical service give you the benefit of a prolonged and varied experience. Take advantage of our numerous resources which are always available to you.

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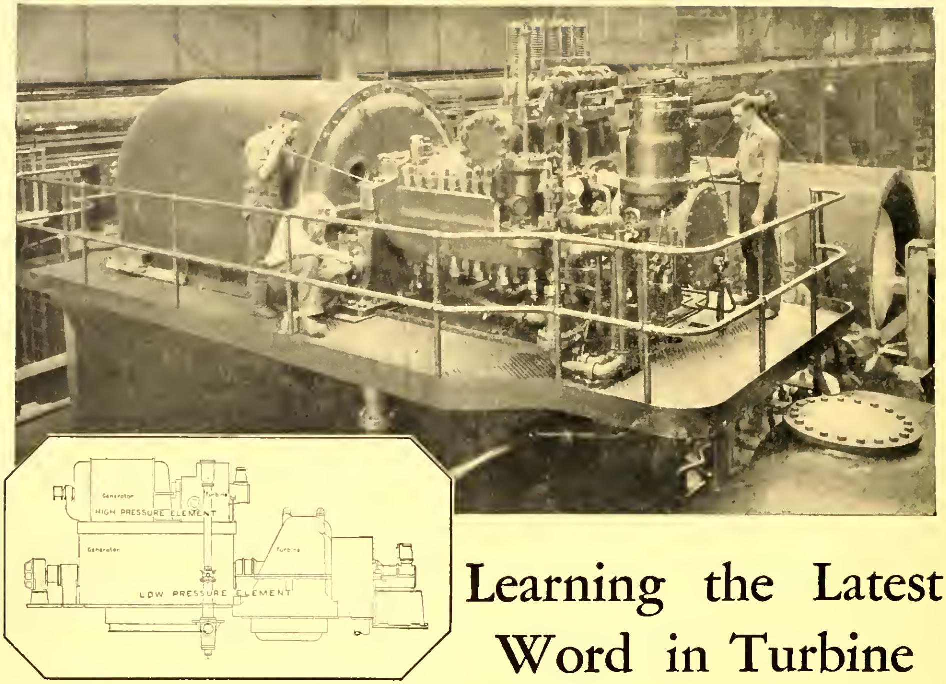

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